MODERN METHODS OF FEEDING IN INFANCY AND CHILDHOOD

IF I WERE KING

If I were King of England,
What lots of things I'd do;
What plans I'd make,
What pains I'd take,
To have things nice for you.

First I would issue orders
That, to all sorts and ranks
Of girls and boys,
All sweets and toys
Were sold for 'please' and 'thanks'.

Christmas would happen once a month
And birthdays once a week,
And in the schools
They'd teach the rules
Of naught but hide and seek.

Nurses should go to bed at six
However much they'd scream;
And you should dine
At half-past nine
On strawberries and cream.

And I should have great puddles made
In every single street,
Where you could play
The livelong day
And splash them with your feet.

Oh that would be a wondrous time;
For every single thing
That ever you had wished were true
Would be—if I were King.

(Written by Richard Francis Kindersley, October, 1932.)

MODERN METHODS OF FEEDING IN INFANCY AND CHILDHOOD

BY

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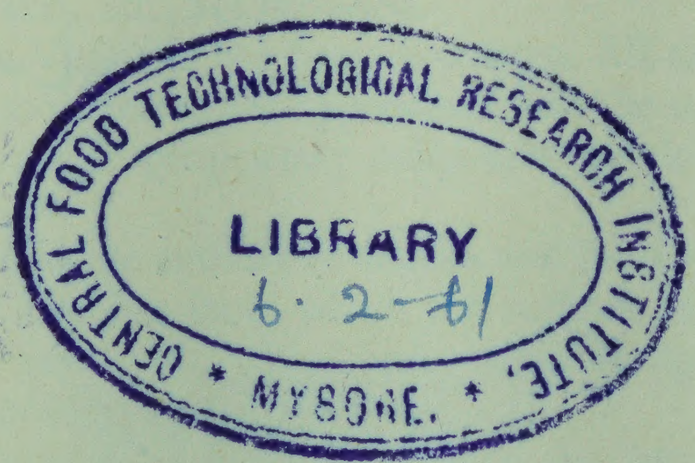

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PREFACE TO THE TENTH EDITION

IN THIS new edition, a change of authorship has taken place, consequent on Dr Donald Paterson's departure from this country to live in Canada. He has, however, given valuable advice in the preparation of this edition, especially in regard to the chapter on artificial feeding and the feeding tables. The general format of the book has been preserved and the basic principles of infant feeding, for which the book was well known, have been retained. The book has however been thoroughly revised and brought up to date and some parts have been re-written.

In the chapter on Breast Feeding, sections on the anatomy and physiology of the breast, the treatment of engorgement of the breast, and the feeding of twins have been included.

In the chapter on Artificial Feeding of Infants, much of the old material has been discarded and the methods of feeding have been simplified. Changes have been made in the feeding tables for infants, so as to provide larger quantities and a higher calorie intake for the average infant, thus avoiding underfeeding. The food tables for the older infant and toddler have been revised to bring them into conformity with the generally accepted practice of early mixed feeding.

The chapter on Vomiting and Diarrhœa has been enlarged and a section on Colic added. The section on the Premature Infant has been expanded.

Some additions have been made to the chapter on Diets for Sick Children; for example, the low sodium diet in nephritis and the gluten-free diet in Cœliac Disease; recipes for making wheat-starch biscuits, cakes, etc., are included.

The section on Vitamins has been re-written. All the tables in the body of the book and in the appendices, and the composition of the various types of proprietary milks and cereals have been brought up to date.

Thanks are due to the authors of articles and books on various aspects of Infant Feeding from which the authors have derived assistance in the revision of this book; acknowledgements are made in the footnotes.

We are also indebted to Miss Dillistone for her help with the chapter on Diets, to Mr Martin for the new photographs and to Mr Cull for the two diagrams, and also to Miss Mary

Hook for her help in the preparation of the typescript and the compilation of the index.

It is hoped that this book will continue to be of value to doctors, nurses and mothers.

D.P.
G.H.N.

July 1955

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CHAPTER ONE

BREAST MILK AND NORMAL BREAST FEEDING

THE ADVANTAGES of feeding a baby at the breast are so numerous that it should not be necessary to stress them. Yet breast feeding is still too often abandoned with little or no effort to make it a success. The safety and relative simplicity of artificial feeding has led many mothers to prefer it to breast feeding for trivial reasons or because of temporary difficulties.

Every mother should realize that breast-milk suits nearly all babies, and that most women can wholly or partially breast-feed their infants.[1]

Advantages to the Baby of Breast Feeding

1. Breast milk is the natural food for the infant, and no artificial food, even with the most elaborate modifications, can approach it in composition. Breast milk is a perfectly balanced food, and its protein, fat and carbohydrate are particularly suited to the infant's digestion.

2. Infants who are breast fed by healthy mothers having abundant milk thrive well, gain weight steadily and remain contented and sleep well.

3. Breast milk is normally free from harmful bacteria, and the milk received by the infant is virtually sterile. Intestinal infections, which may be serious in young infants are, therefore, much less likely to occur in breast-fed as compared with bottle-fed infants.

4. Statistical surveys show that both the morbidity and the mortality of breast-fed infants is lower during the first few months than in bottle-fed infants. In the U.S.A. Stevenson[2] showed that bottle-fed babies develop a significantly higher number of respiratory infections in the second six months of life than do those who are breast-fed for three or more months.

5. Gyorgy[3] has demonstrated the presence of a specific growth

[1] Ministry of Health Advisory Committee on Mothers and Young Children (1944) *Rep. Publ. Hlth, Med. Subj. Lond.*, No. 91.

[2] Stevenson, S. S.: *J. Pæd.* (1947). 31, 616.

[3] Gyorgy, P.: *Pædiatrics* (1953), 11, 98.

factor in human milk. He found that a strain of bacillus (*L. Bifidus*) present in the intestine of breast-fed babies would not grow unless human milk was added. Cow's milk has only about 1/40 of the same activity. This growth factor from human milk has been shown to stimulate the growth of young rats fed on dilute cow's milk. It also increased the utilization of protein. This new discovery may provide a scientific explanation of the superiority of human over cow's milk.

6. Providing the mother's diet is adequate the breast-fed baby is less likely to suffer from rickets or scurvy than the infant fed on cow's milk alone.

Advantages to the Mother

1. Breast feeding is easier than bottle feeding; no bottles have to be sterilized or feeds prepared. It is also cheaper.

2. One great advantage of breast feeding is the emotional satisfaction which both mother and child derive from it. It brings the two constantly into close contact with each other, thereby giving the infant a sense of comfort and security.

Breast feeding does, of course, take up a considerable portion of a mother's time, and she must be willing to sacrifice herself in this respect. One cannot delegate breast feeding to a nannie. Social duties must be given second place if a baby is to be breast-fed. Some women have to abandon breast feeding because they have to go back to work within a few weeks of the birth of the baby. Unless it is imperative for the mother to return to work, she should remain at home to breast-feed the baby for at least three to four months.

Though the doctor should do all he can to encourage breast feeding, a doctrinaire attitude should not be taken. After all, infants *can* be reared on artificial foods. Some women do have inescapable social duties, and many others find that the responsibility of managing a home, often with inadequate help, results in the breast-milk supply failing.

A small proportion of women do not seem able to feed their children. In these there may be an inadequate amount of secreting tissue in the breasts. Lobules or even more extensive areas may fail to reach maturity.[1]

[1] Engel, S.: *Brit. J. Dis. Child.*, 1941, 38, 41.

In some cases breast feeding makes the mother tired and exhausted even though she has ample food and sufficient rest. This is most likely to occur in older women.

Many women fear that breast feeding will ruin their figures. Pregnancy causes some women to become fat, but their usual weight is slowly regained after the baby is born. Obesity is not caused by breast feeding, unless the mother eats excessively, which is not necessary. Some extra intake of food and milk is, of course, required to provide for the needs of the baby. In most cases the size and shape of the breasts are not altered by breast feeding. They return to their previous state after the infant is weaned. It is important to wear a good brassière during pregnancy, as well as during the period of nursing.

A few mothers seem to have a deep repugnance at the thought of breast feeding. If such women are forced to feed their infants, they may develop antagonisms which may seriously interfere with the mother-child relationship. It is essential for the doctor to study the individual woman when advocating breast feeding, as he will have to study the individual child when practising artificial feeding.

Contra-Indications to Breast Feeding

A mother with active Pulmonary Tuberculosis should on no account nurse her baby, as the risk of infection is very high. Young infants are extremely susceptible to tuberculous infection. Healed Tuberculosis is obviously no contra-indication.

In severe acute infections, e.g. Pneumonia, Typhoid, the mother is too ill to nurse her infant. Modern treatment with antibiotics cuts short the duration of these acute infections, so that it may be possible to re-establish breast feeding, provided the breasts are kept emptied during the illness. As a rule, chronic severe illnesses, such as Nephritis, Heart Disease, etc., may prevent the mother feeding her infant, though there may be exceptions. Malignant disease, if it involves the breast or is extensive elsewhere, will obviously preclude the possibility of breast feeding. Diabetes is not a contra-indication to breast feeding.

Syphilitic infants should be nursed by their mothers when possible. These infants are very prone to digestive upsets, and while being treated should be kept on the breast. The duration of

treatment has been reduced to 2–3 weeks following the introduction of penicillin.

The effect of local disease of the breast, e.g. sore nipples, breast abscess, etc., on breast feeding will be discussed under difficulties of breast feeding.

In Epilepsy and Insanity the mother may be physically able to nurse her offspring and breast feeding may, in selected cases, be advised. Care, however, must be taken to protect the infant from physical violence during a fit or outburst.

The occurrence of menstruation is not an indication for weaning. If pregnancy occurs in the lactating mother, the breast milk supply may diminish, especially if she has severe morning sickness. Many mothers can, however, continue suckling their infants during the first few months of pregnancy. The mother may, however, find the strain of nursing too great. It is claimed that continuation of nursing during the latter half of pregnancy tends to cause miscarriage.

We have given the contra-indications at the outset, in order to emphasize that a small proportion of children *must* be brought up on artificial foods. With care, most infants can be given natural food; breast feeding for a month only is better than none at all. In all cases of doubt, decide against bottle feeding.

Colic, vomiting or failure to gain weight are not indications for weaning. These symptoms are generally due to underfeeding. This subject is discussed on pages 117-126.

COMPOSITION OF HUMAN MILK

Colostrum is the term applied to the fluid secreted by the breast in the first few days after parturition. It is a thin, yellowish fluid which has a high protein content (up to 5 per cent), much of which is present as globulin, mineral salts and some sugar and fat. On microscopic examination large endothelial cells—known as colostrum cells—may be seen.

Colostrum appears to have a laxative effect, but this may be due to the setting up of the gastro-colic reflex when the fluid is taken into the infant's stomach. Because of its high globulin content, colostrum has been credited with immunizing properties. Though

this has been shown experimentally to be the case in animals, it has not been proved in human beings.

The amount of colostrum secreted is small—100 c.c. a day on the average—and so can be of little value in providing fluid in the period before lactation commences.

Milk

The chief constituents of human milk are fat, protein, sugar, minerals, water and vitamins. The average composition of human milk is shown in Table 1. The composition of human milk may vary considerably from one woman to another, and even in the same woman from one day to another. The calorie value is approximately 20 to the ounce.

Table I (Holt)[1]

VARIATIONS IN THE COMPOSITION OF BREAST MILK

Constituent	Normal Average Grams per 100 c.c.	Common Healthy Variations in Human Milk Grams per 100 c.c.
Fat	3.8	2.0 – 6.0
Protein	1.1	0.9 – 1.6
Lactose	7.0	6.5 – 8.0
Mineral Salts ..	0.2	0.15–0.35
Water	88.0	87.0–89.0

Fat

The fat in human milk is more variable than the protein or carbohydrate. It varies from 2 to 6 per cent. The first portions of milk removed from the breast are low in fat, the last portions high in fat. The fat globules are held in a very fine state of emulsion. About a third of the fat consists of oleates, and about half of the fats are unsaturated. Human milk contains much less of the volatile fatty acids which are somewhat irritating to the gastro-intestinal tract. The fatty acids of human milk contain 7 per cent of linoleic acid, whereas there is hardly any in cow's milk. This is one of the essential fatty acids of which there are about twice as much in human as in cow's milk.

[1] Holt's *Pædiatrics*. Holt & McIntosh. 12th Ed. 1953. Appleton. New York.

Proteins

These make up 0.9–1.6 per cent of human milk, in contrast to the 3.5–4 per cent in cow's milk. The proteins of human milk are casein, lactalbumin and lactoglobulin, nearly two-thirds of the total being lactalbumin; whereas over three-quarters of cow's milk protein consists of casein.

Though the amount of protein in human milk is much less than in cow's milk, it has a high nutritional value because of the greater proportion of lactalbumin. It is sufficient for the full-term infant, but in premature or very under-nourished babies supplementary protein must be given to obtain an adequate weight gain. Coagulation of casein by rennin is usually complete in the stomach. The casein curd of human milk is fine and readily crumbles, whereas the curd from cow's milk is larger and tougher, and may fill the whole stomach. This makes the milk much less digestible (see p. 71). Human milk contains one-third less buffer substances than does cow's milk, so that less hydrochloric acid is required to bring the milk to the degree of acidity necessary for gastric digestion. The amount of acid in the infant's stomach is sufficient to allow some peptic digestion of the proteins. Even in breast-fed infants the amount of protein digestion in the stomach is small, the greater part taking place in the small intestine.

It is an interesting point that milk produced in large volume has a high carbohydrate and low protein content.

Carbohydrate

The sugar of human milk is lactose and does not differ from that found in cow's milk. The amount is more constant than that of any other constituent, though variations from 6.5 to 8 per cent may occur. Owing to the higher content of sugar present, human milk is sweeter than cow's milk, which contains 4.5 to 5 per cent.

Minerals

The mineral content of human milk is adequate for the first few months, but is insufficient for the needs of the baby of five to six months onwards, so that mineral supplements become necessary at that age. Cow's milk contains a much higher percentage of minerals, especially calcium and phosphorus, than human milk,

though the latter contains about three times more iron (1 mg. per 100 ml.) than in cow's milk. This is, however, insufficient to meet the infant's needs for haemoglobin formation when the body stores are exhausted. Foods containing iron should, therefore, be given at three to four months. There is more efficient absorption of calcium from human milk, though it contains four times less than the amount in cow's milk.

The sodium chloride content of breast milk is much less than that of cow's milk.

Vitamins

The amount of vitamins in human milk depends on the diet of the mother. If she has an adequate diet, her milk contains sufficient vitamins A, B_2, C and K and folic acid. The riboflavin and thiamin content of human milk is much less than in cow's milk, but in a well-nourished woman is sufficient for the infant's needs. The amount of vitamin D in breast milk is often low, though in most cases sufficient to prevent rickets. In summer months some vitamin D is synthesized in the skin by exposure to sunshine. While scurvy is rarely met with in breast-fed infants, this is not so as regards rickets. A breast-fed baby should be given a supplement of vitamin D from two weeks onward. The total amount required is about 400 to 500 units daily, including that contained in breast milk.

Bacteriology

The bacteria found in human milk are not pathogenic. They usually come from the terminal milk ducts. In cases of mastitis the milk may become heavily infected with bacteria, and should not be fed to the baby unless it is boiled. The milk may become infected if the mother suffers from septicaemia. In the case of tuberculosis the only risk is that the baby may contract the disease by close contact with the mother. Tubercle bacilli do not find their way into the milk unless the breast is tuberculous—a very rare condition.

Variations in Quality of Breast Milk

After the first week of lactation, the composition of human milk

does not vary much. Hytten[1] has recently shown that there is a diurnal variation both in quantity and fat content. An insufficiency of proteins, fats and carbohydrates in the diet results in a reduction in the milk yield. A high protein diet increases the total quantity of milk secreted. The total amount of milk secreted daily depends first on the secretory capacity of the breast, and secondly on the demands of the infant. The main stimulus to milk secretion is the suckling by the baby (see p. 125). Complete emptying of the breast is also an important factor. As a rule, the amount of milk secreted increases with the demands of the infant, but this does not always occur, and some mothers reach a stage when their milk supply remains stationary. Complementary feeding then becomes necessary. Overwork, excessive fatigue and anxiety are liable to decrease the total amount of milk secreted and may lead to weaning.

The amount of milk secreted varies during the day. The first morning feed may be double that of the afternoon feed. The evening feed tends to be larger. It is important to note this fact, as if complementary feeds should prove necessary, the 10 a.m., 2 p.m. and 6 p.m. feeds should be those at which the complementary feeds are first introduced.

ANATOMY AND PHYSIOLOGY OF THE BREAST

The lactating breast consists of a number of lobes divided into lobules, each lobe being separated from its neighbours by connective tissue. The lobules consist of a cluster of rounded alveoli, which open into the smallest portion of the lactiferous ducts. These unite to form the larger ducts, the galactophores, which open on to the surface of the nipple. These are fifteen to twenty in number, and just behind the nipple they dilate to form ampullae which lie behind the areola, and serve as reservoirs for the milk. Just before entering the nipple the ducts contract, so that the orifices are considerably narrower than the ducts. (See Fig. I).

The external surfaces of the epithelium of the alveoli are covered by branching, elongated, longitudinally-striated cells, the so-called myoepithelial cells. They are in effect primitive plain muscle fibres and have contractile functions.[2]

[1] Hytten, F.E.: *Brit. Med. Jl.* (1954). 1. 249.
[2] Richardson, K. C.: *J. Anat.*, 1949, 83, 58.

The nipple itself consists mainly of muscle and vessels. The muscle fibres are chiefly arranged in a circular manner around the base and are responsible for the stiffening or erection of the nipple. Near the base of the nipple, upon the surface of the areola there are numerous sebaceous glands which secrete a fatty substance which has a protective function as regards the nipple. Sweat glands are present mainly near the margin.

The nipple and areola are very richly supplied with sensory nerves. No specific secretory nerves are known to supply the mammary glands.

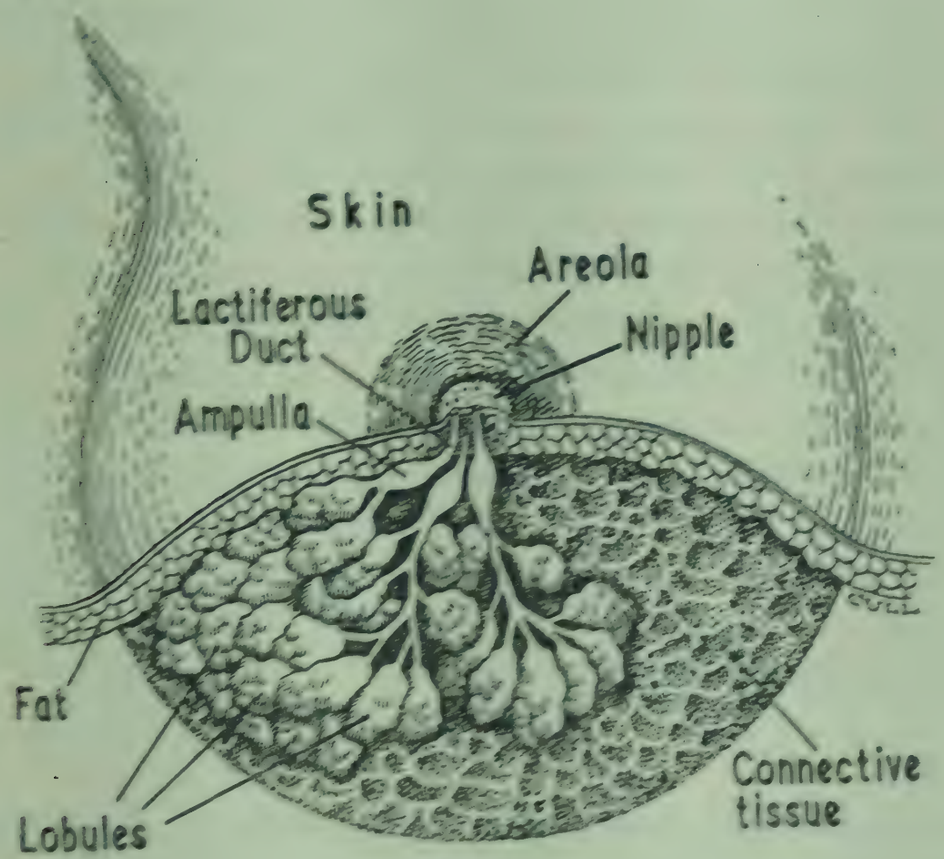


Fig. 1

The Structure of the Human Breast. (*After Gray.*)

At birth the breast is rudimentary, consisting of the nipple, from which radiate a few ducts. The lining cells of these ducts, in the first two or three months of life, may secrete milk under the influence of hormones transferred from the mother. The enlargement of the breasts that occurs in some infants in the neo-natal period usually subsides by the third month. From then onwards, there is very little breast development until the beginning of puberty.

At puberty there is considerable growth and branching of the duct system, and an increase in fat and stroma. The nipple also enlarges. In the early part of pregnancy there is very extensive duct development, and alveoli begin to appear. Little milk is secreted at this stage and it is probably derived from the duct epithelium. During the second half of pregnancy there is a great increase of alveoli, the epithelial cells of which become swollen, and there is a gradual onset of secretory activity.

Breast development is controlled by hormones. The growth of the duct system is caused by oestrogen, which also effects growth of the striae and nipple. For optimal development of the duct system the amount of oestrogen must be maintained within prescribed limits. Excessive amounts may give rise to stunted growth. Progesterone from the corpus luteum has no effect on the undeveloped (non-parous) breast. In pregnant women, progesterone stimulates the growth of the secretory alveoli. High dosages of progesterone will stimulate alveolar-lobular growth, but much lower doses are required in the presence of oestrogen. The effect of progesterone is enhanced by the thyroid hormone. There is a dispute about the role of the pituitary. Some hold that the above hormones do not act directly on the gland but indirectly by the stimulation of the anterior pituitary to produce two hormones Mammogen I and II. The role of the placenta in mammary growth is not yet determined.

Lactation

Lactation consists of two distinct processes, (*a*) the secretion of milk and (*b*) the discharge of the milk from the breast.

Secretion of Milk. This is brought about by the pituitary gland. This is well illustrated by the fact that in Acromegaly secretion of milk may go on for a long time after childbirth, i.e., five years in one case (Cushing). The lactogenic hormone of the pituitary (Prolactin) is responsible for the secretion of milk. It can only act on a breast that has developed as a result of oestrin-progesterone stimulation. The action is directly on the gland alveoli. Recently some doubt has arisen as to whether there is a single lactogenic hormone. Lactogenic activity may be possessed by more than one hormone. The liberation of the lactogenic hormone is brought

about reflexly by suckling, probably by a nervous pathway to the hypothalamus, and thence by a neuro-hormonal mechanism acting on the anterior pituitary. Emotional states, e.g., anxiety, nervous tension, etc., are known to affect the milk secretion, and this is probably caused by inhibitory impulses acting on the pituitary via the hypothalamus. Normal thyroid function is necessary for the maintenance of lactation. There is some evidence that A.C.T.H. is necessary for maximal secretion of Prolactin. Oestrogen in sufficient doses suppresses lactation but under certain conditions oestrogen may function as a galactopoietic agent. Both these effects are probably mediated by the anterior pituitary. Folley[1] has suggested that the oestrogen threshold for pituitary stimulation is lower than that for inhibition.

The Discharge of Milk from the Breast. This is brought about by a reflex action. Stimulation of the nipple causes contraction of the myo-epithelial cells lining the alveoli, which forces the milk into the ducts and so from the nipple. The milk may be ejected for several inches, and this occurs from the other breast as well as from the one suckled. The same effect can be produced by the injection of Oxytocin.

The contraction is usually felt by the mother as a slight pain, aching or tingling. It is called the 'draught' and is similar to the 'let-down' that occurs during the milking of cows. Some mothers feel the draught more than others, but a few never develop any sensation, possibly due to a variation in the level of the threshold of visceral sensation.

The draught does not occur immediately on suckling. There is an interval of half to one and a half minutes after the infant has started suckling. It appears to be a conditioned reflex which may take up to three or four weeks to develop. When well developed the draught may occur before the baby is put to the breast, for instance, when he is brought into the room, or it may be felt at the expected hours of feeding. Psychological causes may affect the expulsion of milk. Anxiety, nervousness, embarrassment, etc., may inhibit the draught altogether and so may interfere with breast feeding. Similar inhibition may occur if the nipple is painful.

The physiological pathways of the draught reflex are by no

[1] Folley, S. J.: *Brit. Med. Bull.*, 1947, 5, 1101.

means certain. Samson Wright[1] suggests that stimulation of the nipple causes impulses to pass (via some unknown pathway) to the supra-optic nucleus, and then along the hypothalamic-hypophyseal tract to the posterior pituitary, causing the release of oxytocin. This is carried to the mammary gland via the blood, where it produces contraction of the muscle cells lining the alveoli.

Thus suckling acts by neuro-hormonal mechanisms to cause both milk secretion and milk discharge, and it is easy to see how psychological factors acting via the hypophyiss may inflence the milk supply.

Though removal of the suckling stimulus is a potent factor in bringing about involution of the breast, the effects of non-removal of milk must not be discounted. Persistent failure of milk withdrawal will lead to failure of lactation.

The Act of Suckling

The mechanism of suckling has in the past not been well understood. The infant does not really suck, except initially when he takes hold of the nipple and most of the areola into his mouth. This sucking action which is very powerful (equal to a negative pressure of 200 mm. of mercury—Gunther[2]) is normally employed in retaining the nipple and areola in the mouth. The action of the baby's cheeks and gums are on the areola. The infant, by a rhythmical squeezing or biting action on the areola, then empties the ampullae, which fill again when the baby's jaws relax. Before each bite the tongue is protruded over the lower gums and then drawn back, pulling the nipple towards the baby's pharynx[3] (See Fig. 2.)

Should the breast be engorged and tense the baby will not be able to draw the areola into the mouth. He exerts all his sucking force on the nipple, which may suffer severe damage. Because the ampullae cannot be compressed the infant is able to obtain little milk. This engorgement is likely to occur at the onset of lactation, and is a potent cause of failure of the milk supply. At this stage, the draught reflex is not fully established, and in the absence of

[1] Wright, S.: *Applied Physiology*, 9th ed., p. 1094. O.U.P. London.
[2] Gunther, M.: *Lancet*, 1945, II, 590.
[3] Naish, F. C.: *Breast Feeding*, Chap. II, 1948, O.U.P.

proper emptying of the breast by the suckling mechanism just described the resulting engorgement may result in suppression of milk secretion.

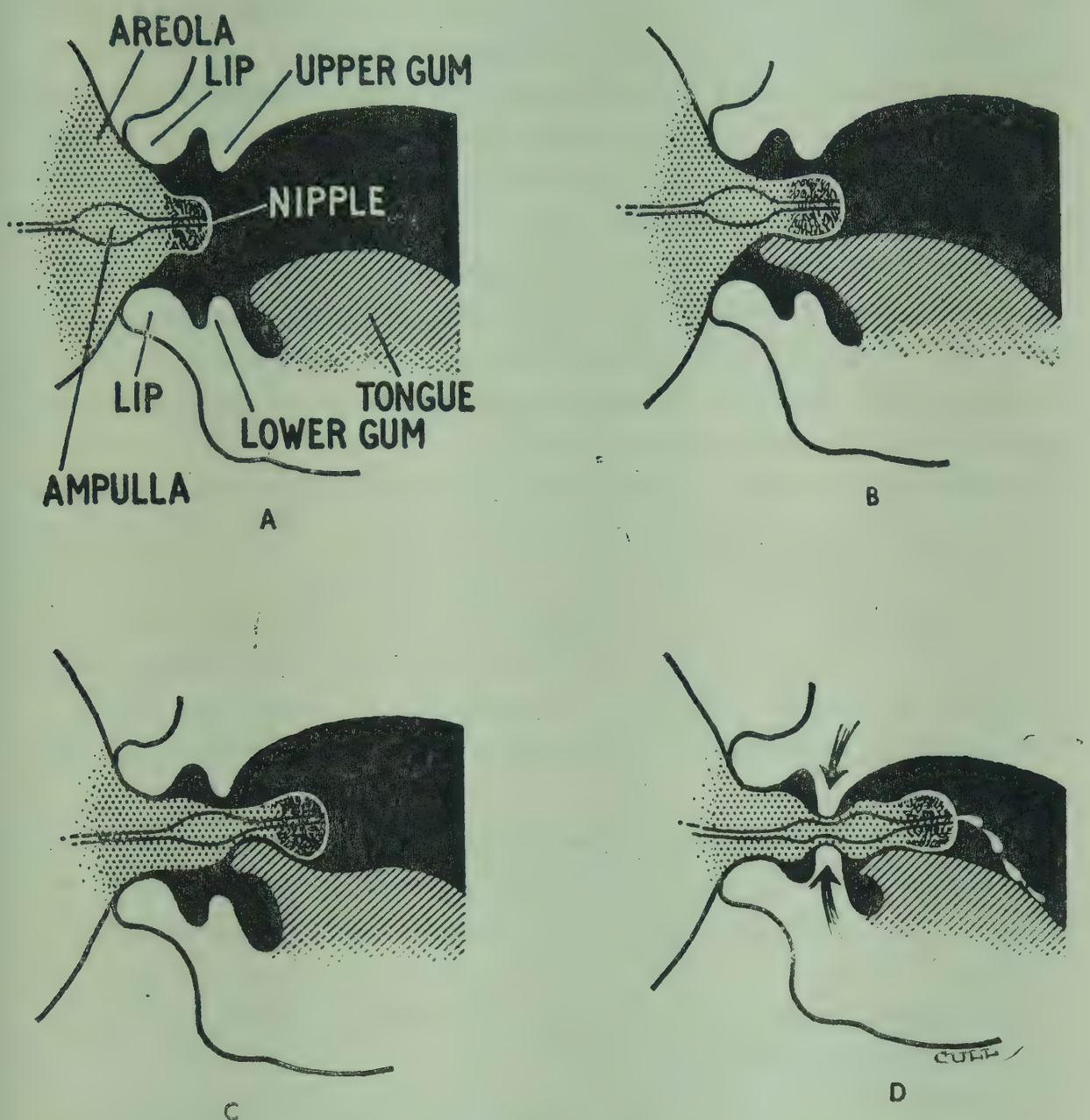


Fig. 2

The Mechanism of Suckling. (*After Naish.*)

When the draught reflex is well established, the infant may get the bulk of the breast milk in a few minutes, and has to make relatively little effort.

The function of suckling is therefore, two-fold; to initiate the reflexes which bring into play the secretion of milk and its expulsion from the breast, and to empty in a rhythmical way the reservoirs beneath the areola.

ANTE-NATAL MEASURES

For efficient lactation and a healthy pregnancy an adequate and well-balanced diet is essential. This should contain: protein in the form of *meat, fish, poultry or game* (one meal at least per day should contain one or more of these articles of diet).

Milk, Eggs, Butter and Cheese: These help to supplement the protein in the diet. One to one and a half pints of milk should be aimed at daily, and up to seven eggs per week are desirable where possible. Cheese is also a valuable article of diet.

The calcium or lime requirements for the bones and teeth of the baby and mother can best be met by the milk and cheese.

Fruit and Vegetables: By the addition of green vegetables, salads, together with fresh or tinned fruit or fruit juice, both salts and some of the vitamins are supplied.

Vitamin Supplements: Concentrated cod-liver oil compound in capsule form (each containing from 1 to 2,000 I.U. of vitamin D and up to 5,000 I.U. of vitamin A daily) is necessary and has been made available by the Government for all pregnant women in Britain. In addition, concentrated orange juice (which provides vitamin C) is also obtainable under the Government scheme. Wheat germ, yeast tablets, Marmite or Bemax will supply additional vitamin B.

There is a tendency for the mother to develop anaemia during pregnancy. This can be prevented by the administration of an iron preparation, such as ferrous sulphate or iron and ammonium citrate.

The importance of an adequate diet was shown in Toronto (1941)[1] by the following facts:

1. Those women receiving an adequate diet (as mentioned above) had better general health during pregnancy, fewer complications during labour and fewer still-birth and premature infants.
2. They were able to breast-feed their infants more efficiently.
3. The infants were larger at birth and had much better general health up to the age of one year.

Ante-Natal Preparation of Breasts and Nipples

The preparation of both breasts and nipples should be started

[1] Ebbs, J. H., Tisdall, F. F. and Scott, W. A.: 1941, *Jour. Nutrit.*, 22, 515.

in the last three months of pregnancy. If this is efficiently carried out, failure to establish lactation, the discomfort of engorged breasts and the risk of breast abscess is minimized. If the nipples are small, retracted or malformed, the greatest help can be obtained by wearing a glass shield inside the brassière. This shield is pressed tightly against the breast, except in the region of the nipple, which is allowed to bulge or protrude through a small centre opening. It is known as a Waller's Shield, and is made by Maw & Sons. (See Fig. 3.)

The importance of teaching mothers the technique of removing milk by manual expression (see p. 174) should be emphasized. This should be carried out daily for the last 6–8 weeks before term. By this technique the ducts are kept clear of thick colostrum and at the same time become distended. Free flow of milk in the first week is more likely to occur. Waller[1] showed in a controlled experiment that those who carried out this technique had a far easier start in breast feeding than the control group and twice as many were wholly breast feeding their infants at six months as compared with the control group.

It is often recommended that the nipples should be washed daily with soap and water, and alcohol applied to harden them. Newton[2] has shown that the use of soap solution is related to a high degree of nipple pain and nipple damage. Soap removes the dead, horny cells which form part of the protective covering and also removes the secretions of the sweat and sebaceous glands. Sebum also has a protective function and keeps the skin pliable. Soap alkalinizes the skin and this leads to an increase of the bacterial flora. Concentrated alcohol hardens the tissues by abstracting their water and precipitating their protein. This leaves the skin less pliable and liable to fissure. *For these reasons soap and alcohol should not be used on the nipple.*

There seems no point in trying to sterilize the nipple by the application of antiseptic solutions and ointments. There are natural mechanisms which greatly reduce the number of bacteria on the nipple. The largest sweat glands in the body are found here. Sweat, together with sebum, has a bactericidal property and human

[1] Waller, H.: *Arch. Dis. Childh.*, 1946, 21, 1.

[2] Newton, N.: *J. Pediat.*, 1952, 41, 411.

milk, owing to its high globulin content compared with cow's milk, exerts an antibacterial action.

DIET AND HYGIENE OF THE NURSING MOTHER

The quantity and composition of milk bears a complicated relation to the diet. A good milk can only be formed from a good diet. A rich diet does not increase the total yield, unless it has a high protein content. If the diet is insufficient, the body tissues are used to form milk, and weight is lost. Later in lactation the milk yield is reduced. The vitamin content of milk is determined by the amount in the mother's diet.

We have already discussed the diet of the pregnant woman and would emphasize that the diet for a nursing mother should be similar. She does not require a special form of diet, but it should contain plenty of first-class protein. Protein intake has an important influence on the amount of milk secreted. Milk, butter, cheese, eggs, meat, fish and vegetables and fruit, should be included in the diet. As the calorie value of the milk secreted varies from 300–800, these extra calories must come from the mother's diet, so that she must take some extra food to provide these.

The excessive use of milk should be avoided. So many mothers will not tolerate milk or milk foods to excess without getting digestive upsets. 1–1½ pints a day is adequate, including that used in milk puddings. Extra vitamin D is essential in addition to that contained in the diet. About 800–1,000 units daily should be given either as cod-liver or halibut-liver oil or in one of the concentrated preparations.

The fluid intake should be 3–4 pints daily. Large amounts appear to be unnecessary. Women should be instructed to drink according to their needs.

Constipation is best treated by the increase in the amount of greenstuff and fruits eaten and by exercise. If drugs are necessary, senna pods, cascara or powdered rhubarb may be used. Saline aperients are to be avoided owing to their tendency to diminish secretion by increased loss of fluid. Minor digestive trouble and other forms of ill-health may be treated in the ordinary way, and without fear of the baby being affected by drugs excreted in the milk.

Fig. 3 (*a*)
Waller's Glass Nipple Shield for the treatment of small, retracted or malformed nipples.

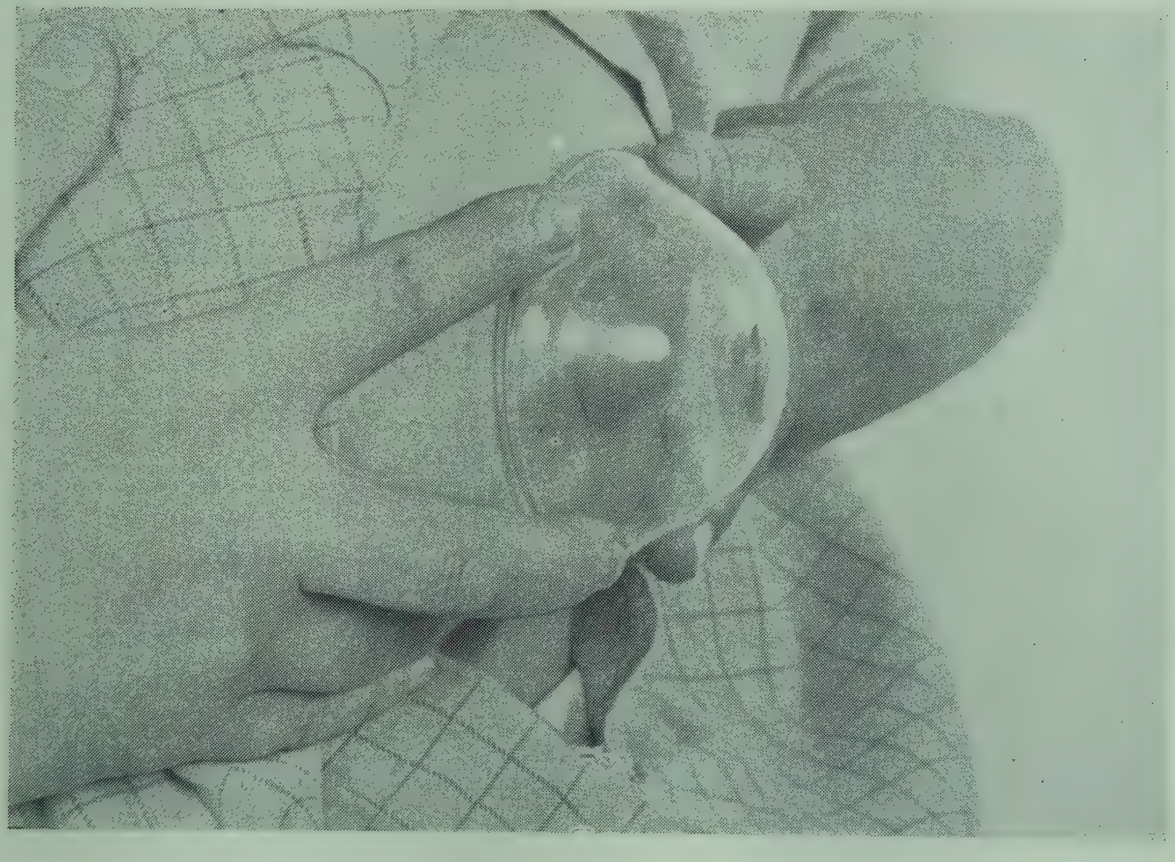


Fig. 3 (*b*)
Waller's Glass Nipple Shield. To show the method of application to the nipple.

[*To face p. 28*

Fig. 4

To show the position of the infant during breast feeding. By pressure on the breast by the mother's index and middle fingers, the breast is prevented from occluding the infant's nose.

To face p. 29]

EXCRETION OF DRUGS IN THE MILK

Drugs excreted into breast milk may be divided into two groups:[1]

1. Those which may be excreted in sufficient quantities to affect the infant, e.g., bromides, aloes, cascara, calomel and phenolphthalein. Infants whose mothers are taking bromide have developed bromism.

2. Those which are excreted in such small amounts as to be harmless. These include penicillin, sulphonamides, barbiturates, iodides, salicylates, quinine and atropine, morphine and codeine.

It will be seen then that the practitioner can, with ordinary care, prescribe almost any drug he may think necessary for the treatment of ill-health arising in the nursing mother.

Moderate amounts of tea, coffee and alcohol have no deleterious effect on breast milk. Alcohol is excreted only in traces, unless excessive amounts are taken. On the other hand, alcoholic beverages, e.g., stout, do not as claimed, increase the secretion of breast milk. Moderate smoking is not harmful, since nicotine is excreted only in small quantities in the milk.

With regard to general hygiene, it is essential that the mother should keep herself in good condition and that she should have plenty of sleep and adequate rest. She should, if possible, have an hour's rest in the afternoon, and return to bed as soon as the last feed is finished. She should take the opportunity of getting out into the fresh air every day, even if only for a short walk or sitting in the garden. As far as possible, the mother should be spared worry and mental strain, as this will affect her milk supply. Unfortunately the strain of ordinary life and the burden of caring for other children with little or no home help makes mothers so overtired that their breast milk may gradually fail.

TECHNIQUE OF BREAST FEEDING

Normally a baby sleeps for about twelve hours after birth. It has been customary in the past to put the baby to the breast after this period. The reasons given are that this teaches the baby to suck, and provides him with some fluid in the form of colostrum and helps to bring in the milk. Certainly secretion of milk will not

[1] Burn, J. H.: *Brit. Med. Bull.*, 1947, 5, 1113.

take place until the production of Prolactin has reached a sufficient level, and that is not before the third or fourth day. As described above, suckling is the stimulus which initiates the production of Prolactin. As already stated the volume of colostrum is low, little more than 100 c.c. daily and can therefore, make little contribution to the fluid intake.

Often the baby is left at the breast too long, and being unable to obtain much food, tends to bite the nipple and may cause fissure. The best plan is, therefore, to leave the infant alone for twenty-four hours. If he seems thirsty, some glucose water should be given by spoon. Thereafter the baby can be put to each breast every four hours for not more than two minutes until the milk begins to come in. These are essentially practice feeds to enable the infant to learn how to suckle. After each feed, an ounce or two of 5 per cent glucose and water should be given, preferably by spoon (so that the baby does not develop a preference for the bottle). It should not be necessary, in full-term normal infants, to give milk feeds in the interval before lactation commences.

Times of Feeding

How frequently should a baby be fed once the milk has come in? At one time there were fierce arguments between the advocates of three-and four-hourly feeding. Most full-term babies can be fed at four-hourly intervals, but some become restless and cry after three or three-and-a-half hours, and require feeding at three-hourly intervals. Four-hourly feedings have many advantages; they give the mother more rest between feeds; the baby has a longer sleep, and his stomach has time to empty completely before the next feed is given. With three-hourly feeding the baby is put to the breast at 6 a.m., 9 a.m. 12 noon, 3 p.m., 6 p.m., and 10 p.m.; four-hourly feeds are best given at 6 a.m., 10 a.m., 2 p.m., 6 p.m., and 10 p.m. These feeding times should not be rigidly adhered to, and if the baby is obviously hungry before the feed is due, he should be put to the breast. Similarly, if the baby wakes at 5 a.m., he can be fed if he is hungry. The last feed at night can often be given at 11 p.m. if the baby is asleep at 10 p.m.

The giving of night feeds is a controversial question. Many babies soon learn to sleep through the night. A minority, however,

persistently wake about 2 or 3 a.m. and cry from hunger. They will only be satisfied with a breast-feed. In these cases night feeding is justified. Such babies do not develop a habit of wanting night feeds. After a few weeks they seem to be able to do without the night feed and sleep until the early morning.

Time taken over the Breast-Feed

The time taken over the breast-feed depends on the strength of the infant and the amount of milk available. Weakly infants take longer to feed, and if the breast-milk supply is scanty the baby is apt to be kept at the breast to obtain the last drop of milk. Usually much air is swallowed as well.

A normal baby gets the bulk of his food from each breast in the first five minutes, and in practice fifteen to twenty minutes will usually be found enough to give him an adequate feed from both breasts. Both breasts should be suckled at each feed. The left breast is given first at one feed, and the right breast is given first at the next feed. The second breast may not be completely emptied by the baby. The above method ensures that one breast is completely emptied at each feed. The stimulation by suckling of each breast at each feed ensures a greater supply of milk.

Nursing Position

The position of the baby during nursing is important. For the first feeds the mother will feed the baby lying down. This is a much easier method while the mother is in bed. The baby should be placed in a semi-upright position on the arm with the head well supported. The other hand should be used to guide the nipple into the baby's mouth, and to keep a grip on the breast, so preventing an excessive flow of milk and the tendency for pendulous breasts to interfere with the baby's respiration. When the mother is up and about the feed is best given from a low chair with the baby in a semi-erect position. This favours the eructation of air. The baby should be taught to grasp not only the nipple but the areolar tissue behind the nipple in the mouth when suckling, and the gums should be pressing on the breast tissue, well behind the nipple and not on the nipple itself. Care must be taken to prevent his gulping milk by keeping firm pressure on the breast. The infant must

never be allowed to sleep at the breast. A little milk squeezed out of the breast into the baby's mouth at the beginning of the feed will usually start the suckling reflex. (See Fig. 4.)

At the end of the feed the baby is supported in an upright position to allow swallowed air to be eructated. This may take as long as fifteen minutes, and several 'lots of wind' should be brought up if the infant is to be comfortable until the next feed. With some infants it is necessary to interrupt the feed half-way through to get up the wind. If the wind is not eructated, the infant will be restless between feeds, and will have colicky spasms of pain. He may also vomit some of the feed. (See Fig. 9.)

The nipples after feeding should be gently bathed with warm water, and examined to detect any soreness or incipient cracks. Lanolin ointment is a useful application in such cases.

It is not necessary to sponge out the infant's mouth. In fact, this is a practice to be condemned, as it may cause infection.

The amount of milk required by the average breast-fed infant is three ounces per pound of body weight per day. Obviously the best indication that a baby is obtaining enough milk is if there is a satisfactory gain in weight. A baby loses up to five to seven ounces in the first four to five days after birth, and should regain this weight by the tenth day, or at the latest, by the fourteenth day. It may take longer if the milk comes in late, or the baby is slow in suckling. Test weighing (see p. 46) for at least one day is necessary to determine if the baby is receiving enough milk, since the amount at individual feeds varies widely. Very often it is found that the quantity taken is less than two ounces per pound of body weight up to the seventh or eighth day, but thereafter it increases. One should be careful not to rush to give complementary feeding at this stage, unless the weight continues to drop or the baby is obviously hungry. If breast feeding is proceeding satisfactorily by the tenth day, one may assume that there is an adequate milk supply.

A baby should gain seven to eight ounces a week. A smaller gain usually indicates under-feeding. Some thriving breast-fed infants gain as much as ten or twelve ounces a week. On no account should the amount of the breast-feed be reduced in such cases for fear of overfeeding (see p. 49).

Vitamin Supplements

Supplements of vitamins A and D should be given from two weeks onwards, one teaspoon of cod-liver oil or four drops of halibut-liver oil daily. This is best given immediately before breast-feeding spread over the day.

Vitamin C supplements are probably not necessary for the breast-fed baby, but it is the practice to give orange juice, black-currant purée, rose-hip syrup or tomato juice from one month onward, in doses of one to four teaspoons diluted with an equal quantity of water and diluted with sugar, given from a teaspoon.

ENGORGEMENT OF THE BREAST

Engorgement of the breast is not uncommon. It develops, as a rule, from the third to the fifth day, but may occur later. Waller attributes engorgement to inadequate emptying of the breasts, though Naish considers that the breasts are overfull, not of milk, but of blood.

Newton and Newton[1] have shown however, that, using pitocin to cause the breast to discharge its milk (artificial 'let-down'), the degree of engorgement increases with the amount of milk in the breast. They postulate that engorgement begins with the retention of milk in the acini, which being distended, compress the surrounding milk ducts. This reduces the outflow of milk, and may lead to secondary lymphatic and venous stasis. Important causes of primary retention of milk in the acini may be failure of the draught reflex, feeble suckling on the part of the infant, and rigid hospital routines, which do not allow sufficient time for adequate emptying of the breasts.

Waller[2] maintains that the main cause of breast engorgement is blockage of the ducts by epithelial debris and dried secretion, and that this can be obviated by regular expression of the fluid from the breast in the last three months of pregnancy and before the milk comes in. It is certainly true that engorgement is a potent cause of failure of lactation, since the distension of the acini causes flattening of the secreting epithelium, so that milk secretion

[1] Newton M. & Newton N.: *Am. J. Obst. & Gyn.*, 1951, 61. 664.

[2] Waller H.: *Clinical Studies in Lactation.* Heinemann, 1939.

gradually stops. Distension of the breast also causes interference with the capillary circulation surrounding the acini.

Emptying the breast by the infant is extremely difficult as he cannot draw the areola into the mouth. The infant tends to bite on the nipple, and makes frantic efforts to get milk. This trauma to the nipple frequently gives rise to fissure. There is evidence that stasis of milk in the breast predisposes to infection.

Massage of the breast to express secretion in the late months of pregnancy, and in the puerperium before the milk comes in, will go far to prevent engorgement.

When the milk begins to come in, care should be taken that the breasts are emptied after feeding. If not, manual expression should be carried out. Often frequent short feedings are better than longer, less frequent ones. When engorgement has occurred, every effort should be made by the mother or the nurse to empty the breasts by manual expression. Manual breast pumps are not very satisfactory, but the type of electric pump that imitates suckling may be used. Expression is often extremely painful at first, and the mother will need every encouragement, since for a day or two the amount of milk expressed is small.

Oestrogens may be given to inhibit lactation for a short period and so relieve engorgement. Five mg. doses of Stilboestrol or Hexoestrol may be given before each breast-feed if the mother feels a sensation of tightness in her breasts. From 3 to 18 doses may be necessary.[1]

FEEDING OF TWINS

Many twins are born prematurely, or are small at birth and have to be treated in the same way as premature infants, being fed on expressed breast milk. When they have reached a weight say of five pounds and are able to go on to the breast, the question of the method of feeding will then arise.

If the mother has sufficient milk to feed both babies, she can breast-feed them either by the alternate or simultaneous method. In the former she first feeds one baby at say the right breast, then feeds the second baby at the left breast. At the next feed the second baby is given the right breast, and the first the left, and so on. This

[1] Robinson, M.: *Brit. Med. Bull.*, 1947, 5, 1106.

method of feeding takes thirty to forty minutes, plus the time taken to bring up the wind.

Simultaneous feeding is recommended by Naish[1] who considers that simultaneous suckling stimulates milk production. The mother can sit or lie, with large cushions placed under each arm, on which the infants lie with the legs behind the mother, who can then hold the infants heads up to the breast. This method takes half the time needed to feed the babies separately.

If the milk supply is inadequate for both infants, complementary or supplementary feeds may be given. In the former, each baby is given the breast, alternately or simultaneously, and a bottle feed is given afterwards. Unless the mother has some help, the feeding takes a long time, and one of the babies has to wait a considerable time for his complement.

In supplementary feeding, one baby is fed at both breasts, and the other is given a bottle. At the next feed the twins are reversed. This giving of a bottle, however, may cause the infants to suckle less effectively at the breast. Another method of feeding twins when the mother has insufficient milk is to breast-feed one entirely, and to bottle feed the other. If there is some help, both babies can be fed simultaneously. It is probably wise to feed the less sturdy of the two at the breast.

Breast-feeding of twins is in any case not usually possible for most women for longer than about three months by which time the infants will be 10–12 lb., when it is necessary to start weaning.

WEANING AND THE COMMENCEMENT OF MIXED FEEDING

Weaning should always take place gradually, for by this means the tendency to minor disturbances in the infant is avoided, and the mother's secretion, lacking the regular stimulation of suckling, is slowly diminished and painful engorged breasts are prevented. It is advisable to wean in cool rather than in warm weather, where possible.

At what age should some addition to the breast milk be made? We think the addition of vegetables and cereals should not be delayed beyond the age of three or four months, or when the baby

[1] Naish, F. C.: *Breast Feeding*, Chap. VII, 1948. O.U.P.

has reached the weight of 12 lb. When an infant reaches 12 lb. he requires about 36 oz. of breast milk in the day. The majority of mothers are not able to secrete more than this quantity without detriment to their own health. Something more than breast milk seems to be required by these infants. The bulk of the milk becomes so great that there is a tendency for the stomach to be overfilled and more concentrated food is necessary. Moreover, at about five to six months, the iron stores of the infant's tissues become exhausted, and it is necessary to add some iron-containing foods to prevent the baby developing iron-deficiency anaemia.

There is an increasing tendency to start mixed feeding at an earlier age, and as a working rule the attainment of the 12 lb. standard may be taken as a guide to the introduction of this mixed feeding. The child is given a dinner at 2 p.m., of one to two tablespoonsful of bone and vegetable broth. This should be given before the breast-feed, and by spoon rather than from a bottle. Shortly after this the soup may be thickened by the addition of one to two teaspoons of potato or ground rice and one to two teaspoons of hand-sieved vegetables. Alternatively, tinned broth and vegetables, made by Heinz, Libby, Nestlé may be given. The baby is seen to be more satisfied, and all of the breast milk is not withdrawn from the breast. This therefore, constitutes the very commencement of weaning, which by this method, should be an extremely gradual process. The second stage is to give a feed of groats (one-third to one-half teacupful) at the 10 a.m. feed. At 6 p.m. one-third to one-half of a teacupful of some starchy preparation, such as Farex, Scott's Baby Cereal, Robrex, Trufood Cereal Food, Sister Laura's Food, Groats or M.O.F., Robinson's Patent Groats or Barley or Chapman's Whole Wheat Flour or Pablum, may slowly be added. The fourth stage is the addition of half a teaspoonful of the yolk of a soft boiled egg to the groats at 10 a.m. Rusks should not be given except at meal times, and then only when the lower incisors have appeared. All added foods should be given before the breast-feeds. If given afterwards the infant may have taken his fill from the breast and may refuse the other food. (See Diet 1.)

Each of the stages described should occupy one week. The diet should be continued for the succeeding months, the amounts only

being increased. Most women do not breast-feed beyond the age of six or seven months, at which time the infant is completely weaned. This should be done gradually. Breast feeding may be carried on for as long as nine months, but it is not recommended that is should be continued longer than this.

When mixed feeding is started the infant should be encouraged to take the feeds from a spoon, and in many cases he will do so, though he may take two or three weeks to learn. In such cases it is possible to avoid using a bottle. After weaning milk is given from a cup.

The Technique of Early Weaning

It is often necessary to wean a child in the first few months. This may be because of ill health on the part of the mother or for social reasons. When this step has to be taken, the following technique is recommended:

1. On the first day the mid-day breast feed should be replaced by an adequate bottle feed, calculated according to the weight of the infant.

2. The second day the 10 a.m. feed should be replaced by a bottle feed.

3. The third day the 6 p.m. feed should be replaced by a bottle feed.

4. The fifth day the 10 p.m. feed is replaced by a bottle feed. Any breast milk present should be pumped off or expressed. This is most easily done after a hot bath.

5. On the seventh or eighth day the 6 a.m. feed should be discontinued, depending on how quickly the mother's milk diminishes. If the breasts become full, engorged and painful, a hot bath will relax the nipples and the milk can be expressed or pumped off readily.

The Treatment of the Breasts at Weaning

If weaning has been carried out in a gradual manner as described above, there is little danger of breast trouble in the mother. If the mother should complain, relief may be given by supporting the breasts by bandaging. The bowels may be freely opened by means of saline aperients each morning. Care must be taken, however, to

avoid excessive purgation. The breasts tend to be most troublesome at night. If this occurs it is a good practice to empty both breasts completely and then to strap securely for the night. At the end of the weaning period, if the breasts are still secreting, they must be completely emptied and kept continuously bandaged for a few days. Stilboestrol or Hexoestrol should be given in doses of five mg. daily for about ten days as soon as weaning commences. This hormone will prevent engorgement of the breasts, and will gradually suppress the secretion of milk.

DIET FOR A HEALTHY BREAST-FED INFANT FROM THREE TO EIGHT MONTHS

This diet should be introduced gradually over three or four weeks

Feeding times—6 a.m., 10 a.m., 2 p.m., 6 p.m., 10 p.m.

8 a.m. Give a breast feed only.

10 a.m. 1. Boiled milk, 2 oz. / Water, 1 oz. / Sugar, 1 level teaspoonful — OR — National Dried Milk, full-cream or full-cream Cow & Gate, 2 oz. measures / Water, 3 oz. / Sugar, 1 level teaspoonful

To the milk mixture add one, increasing to three, heaped teaspoons of Farex, Robrex, Trufood Cereal Food, Scott's Baby Cereal or Robinson's Patent Groats (these need no cooking); or M.O.F., Chapman's Entire Wheat Food (these need cooking for one to three minutes in a single saucepan).

The cereal should be varied from day to day. Half a teaspoonful of the yolk of a lightly boiled egg should be added to this feed three days a week, and gradually increased to two teaspoonsful if well tolerated.

As the baby grows older the amount and strength of the cow's milk mixture or the dried milk should be increased. At six to seven months of age the baby should be able to take undiluted milk.

2. After this feed give the breast.

2 p.m. 1. Two tablespoons of home-made bone and vegetable broth with one to two heaped teaspoonsful of hand-sieved vegetables, *or* tinned baby soup with vegetables. (Heinz, Libby's, Brand's, Nestlé's.) Later the soup may be thickened with potato or ground rice. These amounts may be increased as the baby grows older. At this stage (six to seven months), a small quantity of puréed apple, apricot pulp, or mashed ripe banana may be added several times a week. Once or twice a week, one or two teaspoons of pounded steamed fish may be given.

2. After this feed give the breast.

6 p.m. 1. Give the same feed as at 10 a.m. but add a different cereal.

2. After this feed give the breast.

10 p.m. Give a breast feed only. At five to six months of age, the infant may take little milk at this feed, and it may be possible to discontinue it.

N.B.—When mixed feeding is started the infant should be encouraged to take the feeds from a cup and spoon, and in many cases will do so thus avoiding the use of a bottle.

Fruit Juice

The juice of an orange or tomato diluted with water and sweetened with sugar, or alternatively, concentrated orange juice, tinned tomato juice, blackcurrant purée

or rosehip syrup—two to three teaspoons daily should be given, diluted with water and sweetened with sugar. Should none of these preparations be available at any time—one 50 mgm. tablet of ascorbic acid daily will help to provide the infant with its Vitamin 'C'. A convenient time for this is between 8 and 10 a.m., or at tea time.

To Prevent Rickets

One of the following should be given—one teaspoon of a good quality cod-liver oil, or four drops of halibut-liver oil, or six drops of a concentrated Vitamin 'D' preparation daily.

Bone and Vegetable Broth Recipe

Place one pound of freshly-chopped bones in a pressure cooker. Cover with water and bring to boiling point, reduce heat and cook for thirty minutes at pressure. Allow the pressure to fall, cool and strain the broth and store in a cool place.

Sieved vegetables can be added to this. Fresh vegetables can easily be puréed in the Moulie Baby Sieve.

CHAPTER TWO

DIFFICULTIES IN BREAST FEEDING

Those Due to Defects in the Child

DIFFICULTY IN establishing lactation may be due to some defect on the part of the infant. The most serious of these are malformations of the lip or palate—*hare lip* and *cleft palate*. In a simple hare-lip suckling is often possible. The operation is usually performed at two to three months of age. For the first few days after operation the baby is fed on expressed breast milk, after which suckling may be resumed. It is usually possible to keep the baby at the breast if there is only a small cleft in the posterior part of the palate. Babies with complete cleft palate cannot suckle, and must be fed by spoon. The infants cannot suck properly either at the breast or from a bottle. Respiration is seriously interfered with during feeding. Moreover, milk regurgitates through the nose. It is possible to continue breast-feeding for months by means of expressed breast milk from a spoon. The mother can be taught how to express her breast milk. (See p. 174.) Some babies with severe cleft palate suffer from an underdevelopment of the lower jaw (micrognathia) and are extremely difficult to feed, as the tongue tends to fall back over the larynx and epiglottis. These infants may have to be kept in hospital for some time so as to be in the care of expert nurses, and tube feeding may be necessary for a time.

Nasal obstruction may cause difficulty in suckling. Nasal catarrh is not uncommon in young infants, and it obstructs the nose so that the infant cannot breathe when suckling at the breast. A $\frac{1}{4}$ per cent Ephedrine solution in normal saline instilled into the nostrils shortly before feeding will usually temporarily clear the nose of mucus. If a purulent discharge is present this must be examined bacteriologically, and nasal drops containing the appropriate sulphonamide or antibiotic instilled into the nostrils.

Congenital syphilis used to be a common cause of severe snuffles from the eighth and ninth weeks, and because of the nasal obstruction and the poor general condition of the infant, feeding

was difficult. Such cases are rare to-day, and can be treated effectively with penicillin.

The presence of *Thrush* in the mouth may interfere with suckling, because the baby's mouth becomes sore. The condition is easily recognizable by the presence of white patches on the mucous membrane of the mouth, which unlike milk patches, cannot be wiped away without causing bleeding. The baby can be fed by spoon for a few days while the thrush is being treated by ½ per cent Gentian Violet in water. An effective remedy recently introduced is ½ per cent Stilbamidine.[1]

Premature infants may be too weak to suckle at the breast. It is then necessary to express the milk from the mother and give it to the baby in a special feeding bottle (Belcroy or Breck) (see p. 140), or if the baby is so immature that it cannot suck, by a spoon or even by an oesophageal tube. Later when the infant has become more mature, breast feeding may be started. A fuller discussion of the feeding of premature infants is given in Chapter Nine. Similar difficulties arise in those infants who suffer from some organic disease, e.g., congenital heart disease. Such a child should always if possible, be fed on milk expressed from the mother (see p. 174), and it cannot be too strongly emphasized that its chance of survival may depend on his obtaining breast milk. It is in many cases quite possible to establish milk secretion without putting the baby to the breast by means of manual expression. As soon as the weakly infant shows signs of returning strength, he should be placed to the breast, and afterwards three-hourly feeding will be found the best method to adopt.

Babies who have had *Intracranial Haemorrhage* or serious cerebral oedema may be unable to suckle for a variable time after birth, during which period they should be given expressed breast milk from a spoon.

There is a type of infant who is born healthy, of normal birth weight, whose mother has an adequate supply of milk, and who yet does not thrive at the breast. When observed, it will be seen that the child 'mouths' at the breast. The nipple is never grasped, and the infant makes no attempt to suck properly. Some of these cases suggest at once a birth injury, or this failure to suck may be

[1] Stilbamidine solutions must be made up fresh every forty-eight hours.

the first sign of mental defect, but in the absence of gross disease, this type of case can only be accounted for by the failure to establish a suckling reflex. Every effort must be made to encourage the infant by expressing milk from the breast from time to time and feeding him on this, and care must be taken not to resort to artificial feeding unless it is unavoidable. The successful feeding of these cases depends almost entirely on the maternal effort or on the personality of the nurse in charge of the case.

Those Due to Defects in the Mother

In the absence of severe illness, this may be due to the lack of ante-natal care, or:

1. Poorly developed breasts
2. Malformation of the nipples
3. Affections of the nipples
4. Breast infections

It has to be recognized that a certain proportion of women who are really anxious to feed their children have mammary glands which contain little true secreting tissue. The poor breast will, however, often yield a certain proportion of milk if every step is taken to encourage secretion. These methods will be discussed later.

Inadequate ante-natal care may result in persistent inverted nipples, severe engorgement of the breast, choked ducts, etc. These have been dealt with under ante-natal treatment. If the nipples are markedly retracted, the baby will experience great difficulty in getting hold of them. Breast pumps, hand or electric, may be used to pull out the nipples, but because they have to be used frequently the nipples and areolae are likely to be damaged. Rubber nipple shields may overcome the difficulty. Often the baby is unable to empty the breast, and may be underfed unless the breasts are emptied after each feed, and the milk given to the baby by spoon or bottle. Generally speaking nipple shields are not very effective. Waller nipple shields (see p. 27) if used before pregnancy, will often draw out quite badly inverted nipples.

Sore and cracked nipples are often the cause of weaning and may cause breast abscesses. To prevent sore nipples, attention should be paid to the following points:

1. Engorgement or overfilling of the breast is most likely to occur in the first and second weeks. The baby cannot bury its face in the breast, and instead of exerting the main pressure of suckling on the areola, it sucks and chews the nipple which at this time is tender and often oedematous. The measures which prevent engorgement should be employed. (See p. 34.) When the breast is overfull a small quantity of milk should be expressed before the infant is allowed to start the feed.

2. Daily application at bedtime of lanolin or 1 per cent yellow oxide of mercury ointment.

3. The nipples should be gently washed with warm water after each feed.

4. No infant should be allowed to remain at each breast more than 10 minutes.

The first symptom of a cracked nipple is pain during feeding. No fissure may be seen by the naked eye, but examination with a hand lens will reveal early damage. Once cracks have developed measures should be taken immediately to promote healing. Suckling through a nipple shield is almost as painful as suckling directly from the breast. A Waller shield may be worn in between feeds to protect the nipples.

The period of suckling at the breast may be shortened, which means more frequent feeds. Where cracks are very deep and painful suckling becomes agonizing for the mother, and it is then necessary to take the baby off one or both breasts, which must be completely emptied by hand or by breast pump to prevent engorgement. This milk can be fed by bottle. All kinds of local applications have been used for cracked nipples, including Friar's balsam and silver nitrate. Both these preparations are irritating. Half per cent aqueous solution of gentian violet is non-irritating and is efficacious, besides being harmless to the infant. Robinson[1] claims that cracked nipples will heal within a few days if 5 per cent Stilboestrol in arachis oil is rubbed in. The oil should be cleaned off before each feed and re-applied afterwards.

BREAST INFECTIONS

Breast infections generally arise in the glandular tissues of the

[1] Robinson M.: *Brit. Med. Bull.*, 1947, 5, 1106.

breast, usually in the third and fourth weeks. Engorgement in the first week, with the difficulties in establishing breast feeding, often lead to cracked nipples, which act as a portal of infection. Milk stasis promotes the multiplication of any organisms that may be present. The ante-natal preparation of the breasts which will allow the milk to come in without difficulty, is an important factor in the prevention of breast abscess. (See p. 26.) Mastitis is favoured by a stay in hospital. When the carrier rate for Staphylococci among the hospital staff or visitors reaches a certain level, epidemic outbreaks of mastitis are likely to ensue. The organism most often responsible is the Staphylococcus aureus, which may not be sensitive to penicillin. In milder forms localized tender areas appear, which may clear up with rest to the breast and hot fomentations. Robinson[1] recommends Hexoestrol five mg. four-hourly, and claims that many cases clear up on this treatment. Frequently, however, these areas spread, and abscess formation may occur which necessitates surgical drainage. By early recognition of breast infection, it should be possible to prevent suppuration. Penicillin should be given in large doses by four or six hourly injections or, if Procaine penicillin is used, by large twice daily injections. Aureomycin or Terramycin are probably preferable in view of the frequency of penicillin-resistant staphylococci in maternity hospitals. If treatment is started early abscess formation will be prevented in most cases. The milk must be drained off completely because stagnation of milk favours the spread of infection. Manual expression will probably be too painful, and a breast pump will have to be used. In early cases the baby may be allowed to suckle at the affected breast, but when abscesses begin to form the milk will contain organisms. Walsh[2] has demonstrated that it is safe to give milk from an infected breast providing it is boiled. Usually breast abscesses will cause a falling off in the milk supply of the affected breast, so that complementary feeds will be necessary.

If abscesses should form in spite of treatment, surgical incision and drainage must be carried out as soon as the abscess is ripe. The infant will have to be fed on the healthy breast until the

[1] Robinson, M.: *Brit. Med. Bull.*, 1947, 5, 1106.

[2] Walsh, H.: *Lancet*, 1949, 2, 639.

abscesses have healed, and given complementary feeds. The affected breast should be kept emptied. Usually the milk flow falls off considerably, but in most cases will return after the infection has healed.

UNDERFEEDING

This is usually due to an infant receiving insufficient breast milk, though occasionally the breast milk has a low fat content, which reduces its calorie value.

Causes: (*a*) Incorrect management of the infant during the first ten days. Engorgement of the breasts interferes with milk secretion, which becomes insufficient for the baby's needs. In these cases complete failure of lactation frequently occurs at four to six weeks.

(*b*) Often the secretion of milk diminishes when the mother goes home and resumes her normal activities. Insufficient rest has an adverse effect on the breast-milk supply.

(*c*) Excessive anxiety tends to diminish milk secretion. The mother may be a worrying type, and if the baby is not thriving her anxiety over the infant's progress may affect her secretion. She 'worries her milk away'.

(*d*) Failure of the milk supply to increase with the growth of the baby. The mother may provide an adequate quantity of milk up to a certain weight, but thereafter the milk supply increases only slowly, and the baby suffers from underfeeding. It is often not realized in these cases what is the cause of the baby's symptoms.

The symptoms of underfeeding are easy to recognize; the infant gains weight very slowly, or the weight may be stationary. Usually the gain in weight is irregular and small in amount. Because less food is passing through the alimentary tract, the baby tends to be constipated, and if very underfed, the stools may be frequent, small in amount and green in colour. These are the so-called hunger stools (which occur for the same reason in pyloric stenosis).

Underfed infants frequently vomit. They are so hungry that at the commencement of a feed they gulp down the milk, and then go on suckling at an empty breast and so swallow an excessive quantity of air, which distends the stomach and forces the infant to vomit.

Such vomits may be quite forcible—often explosive, due to the eructation of air with the vomit, but never projectile like the vomit in pyloric stenosis. This is an important point, as the symptoms of underfeeding may resemble those of the latter condition. Furthermore, some of the air may pass into the intestine, and give rise to excessive peristalsis, which the infant feels as colic. An underfed baby is therefore restless during the day and night, has attacks of colic, vomits frequently, is constipated or passes frequent small green stools. These symptoms are often ascribed to overfeeding (see p. 49), especially if vomiting occurs and green stools are passed. The feeding time at the breast is often reduced, or fewer feeds are given, and the symptoms become aggravated.

Test Feeds

The diagnosis of underfeeding is not difficult. No mother can tell by the size of her breasts, by the apparent flowing away of the milk, or by the tenseness or feel of the breasts, whether they contain little or much milk. There is only one certain way of ascertaining the amount of milk in the breast, and that is by a 'test feed'. The baby is weighed before being put to the breast, and is weighed immediately after the feed without altering its clothes. If a stool has been passed the napkin must not be changed between the two weighings. The difference in the weight shows the amount of breast milk taken. One isolated test feed is of no value but the complete output of the mother for the day should be ascertained to be of any real value. (See below.)

Amount of Breast Milk Required Daily

As each feed varies in amount, and the quantity taken by the baby may vary from day to day, an average of the milk taken by the baby for two or three days should be made. It has already been stated that breast feeds vary in their yield during the day; the early morning feeds tend to be largest, and by noon or early afternoon the feed has dropped sometimes to half the quantity of the first feed. At night again the feeds become bigger. The smallest feeds coincide with that part of the day in which the mother's activity is greatest.

The average normal infant up to four months of age requires 55 to 60 calories, or approximately three ounces of breast milk per

pound of body weight daily; a 10 lb. baby would need 30 oz. daily. It is now recognized that many infants need this amount in order to thrive, and underfeeding may exist when the intake is less than this. On the other hand, a small proportion of babies will gain weight and be contented on small feeds. Individual requirements among babies therefore differ very considerably. It is a matter of common experience that some infants from birth are nervous, sleep badly, are easily disturbed and often cry. They thrive badly and require large feeds to make them get on well. Other infants quite the reverse, sleep well, are 'good' babies and seem well nourished on quite small quantities. We mention these types to make it quite plain that the estimate of the breast milk requirements given is, and can only be, an approximate one. The infant itself is the final judge in this most important matter.

Complementary Feeding

If the baby is underfed as shown by test feeding, complementary feeds should be given. A complementary feed should be defined as a feed given in addition to the breast feed, as opposed to a supplementary feed which is given in place of a breast feed.

While theoretically one should test feed at each feed and give the necessary complement to make up the required amount, in practice this is a complicated method. A fixed complement of 2–4 oz. given after all the feeds or after the three feeds which are most likely to be small, e.g., 10 a.m., 2 p.m. and 6 p.m. is a satisfactory compromise.

The following rules for complementary feeding should be observed.

1. Both breasts should be given at each feed, but at one feed the right should be given first, and at the next feed the left breast and so on.

2. The infant should not be allowed to remain at each breast for longer than five to seven minutes. Suckling at an empty breast causes the baby to swallow excessive quantities of wind.

3. The complementary feed must always be given *after the breast feed* and never before. This ensures that the breasts are completely empty.

4. Complementary feeds should never be made too sweet or the

infant will tend to refuse the breast. A suitable complementary feed can be made from Half-Cream National Dried Milk, Half-Cream Cow and Gate, Ostermilk No. 1, each being made up in a proportion of one measure to 1 oz. of water, or Evaporated Milk, 1 oz. of milk being added to 2 oz. of water with a level teaspoon of sugar. This should be given to the infant either by spoon or bottle.

5. A complement of 3–4 oz. of feed should be offered after the 10 a.m., 2 p.m. and 6 p.m. feeds, which are likely to be the smallest feeds. The baby will refuse the bottle when he has had sufficient milk.

6. Throughout the period of complementary feeding every effort should be made to maintain and increase the mother's supply of milk. (See p. 49).

7. Many mothers have continued for months giving part breast milk and part complementary feeds. As a general rule, however, complementary feeding is not worth going on with if, after all efforts to increase the supply of mother's milk have been made, the mother's contribution is less than 50 per cent of the total daily requirements.

Quality of Milk

When the question of the quality of the milk is discussed we find many authorities, on the one hand, stating that this is never affected to any appreciable degree, and on the other hand, we hear of weaning being advised because 'the milk is blue'. Chemical analysis of milk entails the collection of an average sample from the breast and apart from the roughest methods, some hours' investigation in the laboratory. The usual method of collection is to use a breast pump, reject the first ounce or so secreted, and take a sample of the next, or so-called 'middle milk'. Investigations of the isolated sample taken in this manner, owing to the daily variation in the constituents in breast milk, cannot give very reliable information.

Hytten[1] has shown that it is necessary to collect the complete twenty-four hours' milk output. The use of a breast pump gives a maximum yield. He confirmed that the fat increased and the

[1] Hytten F. E. *Brit. Med. Jl.* 1954, 1. 179.

sugar decreased as the feed proceeded. There is also a diurnal variation in fat content and in volume. Human milk therefore is not a constant product. Hytten has further shown that milk produced in large volume generally has a high carbohydrate and a low protein and fat content. It will thus have too low a caloric value to nourish a child over 11–12 lb.

Methods of Increasing or Maintaining Breast Milk Supply

1. Making certain that the baby empties the breast at each feed. If not, the residue should be expressed by hand. The breast must be empty or nearly empty at the end of each feed.

2. See that the mother has a proper diet (see p. 28), adequate rest and sleep, and that domestic worries be excluded. This latter is not always possible.

3. Inducing in the mother that desire to nurse her infant, which is so essential to success.

4. An adequate fluid intake. Busy mothers often forget to drink enough fluids. A nursing mother should drink 3–4 pints a day, but she should not be forced to drink more than she feels that she needs. The water may be flavoured with fruit juices; malted drinks, such as Ovaltine, Horlicks, Stout and Lactagol, amongst other preparations, have been claimed to increase the flow of milk. The effect on the milk is probably due to the fluid taken.

5. Over-distension of the breast will cause reduction in the milk flow. Increased tension in the acini will cause flattening of the secretory cells and milk secretion will diminish. To prevent over-filling, it may be necessary to feed the infant at slightly shorter intervals than the orthodox four-hourly period, and in some cases an even more elastic régime may be necessary. *It cannot be stressed too strongly, however, that the vigorous suckling of the infant at the breast at regular intervals is the all-important factor in establishing and maintaining an adequate secretion of breast milk.*

OVERFEEDING

Overfeeding, contrary to popular belief, is very rare although it is still frequently diagnosed. If infants are allowed to determine their own requirements overfeeding takes care of itself. If a breast-fed infant takes too much milk he will spit out the excess. Infants

will tolerate large feeds of breast milk without developing any symptoms. Most of the alleged symptoms such as colic, vomiting, loose motions, etc., are in fact, due to underfeeding.

The large gains in weight that breast-fed babies make do *not* indicate overfeeding and in no circumstances should the duration or frequency of breast feeds be reduced.

DIARRHŒA IN BREAST-FED INFANTS

Diarrhœa is rarer in breast-fed infants than those on artificial feeds. The causes may be as follows:

1. Infective gastro-enteritis may occur, but is rare. A baby in hospital, however, may pick up the infection from another child. The symptoms are those of an ordinary gastro-enteritis. Dehydration may develop, and intravenous fluid therapy may be required.

2. Sonne Dysentery may also occur in older breast-fed infants, though like acute gastro-enteritis, it is rare. There are often quite severe constitutional symptoms in the infant, with high fever and the passage of watery stools containing blood and mucus. The symptoms clear up within a few days following the administration of an insoluble sulphonamide or chloramphenicol.

3. Buddingh and Dodd[1] reported a group of infants with stomatitis associated with diarrhœa. The infection occurs most frequently in infants under six months of age. They isolated a hitherto unrecognized virus from the mouth and stools of infants suffering from the disease. Neutralizing antibodies were demonstrated in the convalescent sera of patients. There is little febrile reaction and hardly any constitutional symptoms. Relapses may occur. The course is not influenced by any kind of treatment. Dehydration, if present, should be corrected. The disease is very infectious and spreads rapidly from patient to patient.

4. Diarrhœa may be due to parenteral infection, that is a symptom due to infection in some other part of the body. A careful clinical examination of the ears, throat, chest, and urine should be made to trace any sign of infection. Treatment with the appropriate sulphonamide or antibiotic should soon clear up the

[1] Buddingh, G. J. and Dodd, K.: *J. Pediat.*, 1944, **25**, 105.

diarrhœa. In such cases there is no indication whatever to stop breast-feeding.

5. Diarrhœa due to indigestibility of the mother's milk is rare, and usually occurs in the first two weeks. The maternal milk is sometimes too rich in fat, and this may upset the infant.

6. Overfeeding is a very rare cause of diarrhœa in the breast-fed baby. Underfeeding, however, is often associated with the passage of loose green stools. This is not true diarrhœa. Test feeds will determine whether the infant is being underfed.

CHAPTER THREE

COW'S MILK AND INFANT FOODS

THE ATTITUDE of medical men towards the subject of artificial feeding varies. In some there is a complete indifference, the subject appearing too trifling to bother about, and the feeding of the infant is left to the mother or nurse to manage, or perhaps the advice is given to use patent foods and to follow the directions on the tin. Others, confused by the various systems advocated for feeding the baby artificially, think the subject too difficult, and when the need arises, refer the 'feeding case' to the specialist. An increasing number of doctors, however, realize the importance of a knowledge of infant feeding and while insisting on breast feeding wherever possible, have learnt how to modify the artificial feeds to the individual requirements of the case.

For the rational feeding of the infant by modern methods some knowledge is necessary, not only of the composition of cow's milk with its common variations, but also of the numerous proprietary foods now on the market.

In this chapter are given the main constituents of cow's milk, together with the composition of the more commonly used dried milks, and those milk foods to which starch has been added.

COW'S MILK

Table II shows the composition of cow's milk compared with human milk and Table III the composition of a good 'summer' cow's milk. The proteins are shown as casein, lactalbumen and lactoglobulin; the two latter are known as the soluble protein of milk.

Casein

As will be seen from the above table, casein forms 85 per cent of the protein in cow's milk. Casein is a phospho-protein never found anywhere except in milk. Its exact source is doubtful, but it is suggested that it is made from plasma proteins in the mammary gland itself. A more likely origin, however, is from a

glyco-protein present in small amounts in blood. The phosphorus required for the synthesis of casein is derived from the inorganic phosphorus of the blood.

TABLE II

AVERAGE PERCENTAGE COMPOSITION OF BREAST MILK AND COW'S MILK[1]

	Breast Milk		Cow's Milk	
Water	87.6		87.2	
Total Solids	12.4		12.8	
Protein	1.1		3.3	
Casein		0.4		2.7
Lactalbumin ..		0.4		0.4
Lactoglobulin ..		0.2		0.2
Fat	3.8		3.8	
Lactose	7.0		4.8	
Ash	0.21		0.71	
Sodium		0.015		0.058
Potassium		0.055		0.138
Calcium		0.034		0.126
Magnesium		0.004		0.013
Iron		0.0021		0.00015
Chlorine		0.043		0.100
Phosphorus		0.016		0.099
Sulphur		0.014		0.030
Calories per oz. ..	22		21	
„ per 100 c.c. ..	71		69	

TABLE III

AVERAGE COMPOSITION OF 100 G. OF SUMMER MILK[2]

Major Constituents	Minerals	Vitamins
Water .. .. 87.6 g.	Calcium .. 0.12 g.	A .. .. 150 international units
Total solids .. 12.4 g.	Phosphorus 0.10 g.	Carotene ..
Protein .. 3.3 g.	Magnesium .. 0.01 g.	B_1 .. .. 45 μg.
Fat .. .. 3.6 g.	Iron .. 0.03 g.	Riboflavin .. 150 μg.
Carbohydrate .. 4.7 g.		Nicotinic acid .. 80 μg.
Calories .. 66		B_6 .. .. 70 μg.
		Biotin .. .. 2.5 μg.
		Pantothenic acid 250 μg.
		Inositol .. .. 18 mg.
		C .. .. 2 mg.
		D .. .. 2 international units

[1] U.S.A.: *National Research Council Bull.*, 111, 1950.

[2] *Brit. Med. Bull.*, 1947, 5, 1108.

Casein occurs in milk as calcium caseinate, a tribasic acid, part of which is soluble and filterable, and part of which is not. When acted upon by acid and rennet, a hard curd is formed, which is difficult for an infant to digest. Methods of modifying casein curds are discussed on p. 72.

Lactalbumen

This is closely related to serum albumen, having the same physical and chemical properties, but that it is not identical can be shown by immune reactions. Lactoglobulin is identical with serumglobulin, and carries immune properties. Both these proteins are coagulated by heat but not by rennet. As human milk protein contains 60 per cent of lactalbumen, the stomach curd is much softer than that of cow's milk.

Fat

The fats of milk consist of triglycerides, and in the process of digestion are split into glycerine and fatty acids, which after absorption recombine to form neutral fat. The unabsorbed fatty acids are combined with alkalis to form insoluble soaps.

The proportion of fat in cow's milk may vary considerably and in the milk of Jersey and Guernsey cows it may be over 5 per cent. In fact the breed of the cow has more to do with the composition of the milk than the actual diet which is given to the animal. There is also a seasonal variation (see Table III) and variations due to the skill of the milker and to the relation between the time of milking and the previous calving of the animal. It is well to note the variations in the percentage composition of cow's milk, in order to realize that in the methods described for humanizing milk, the result of dilution and the addition of fat and carbohydrate, gives a mixture the proportion of whose constituents varies with the original composition of the milk used.

In comparison with human milk, the fat of cow's milk contains more of the lower fatty acids, e.g., butyric, caprylic, etc. These are digested well by normal infants, but may have an irritating effect on ill or febrile infants, causing vomiting and diarrhœa. Cow's milk fat also differs from that of human milk in that it contains only about half as much of the unsaturated acids of higher

molecular weight, which include the so-called essential fatty acids. The two milks contain about the same amounts of oleic, palmitic and stearic acids. There is almost no linoleic acid in cow's milk whereas there is about 7 per cent in human milk. This acid is one of the substances indispensable for the nutrition of rats.

Sugar

Sugar in milk occurs only as lactose, a di-saccharide which on hydrolysis splits into dextrose and galactose. Like casein, it is not found in nature except in milk. It is derived mainly from the glucose of the blood.

Minerals

The minerals of milk consist of the salts of potassium, sodium, chlorine and citric acid. Phosphates are in solution combined with calcium and magnesium, whilst di- and triphosphates are in suspension. Cow's milk contains more calcium, magnesium and phosphorus and less iron than human milk. There is about four times as much calcium in cow's milk than human milk, though there is more efficient absorption of calcium from human milk. As the amount of calcium in cow's milk is so much greater more is, in fact, retained than from human milk. The sodium chloride content of cow's milk is much higher than that of breast milk.

The iron content of cow's milk is from 0.2–0.6 gm. per 100 ml. that is, less than half that present in human milk. The iron of the latter is better utilized than that of cow's milk. The normal infant requires 6–12 mg. daily. Iron stores are laid down in the liver during the last two to three months of pregnancy, but these become exhausted by the age of five to six months. Babies fed for prolonged periods on human or cow's milk exclusively are likely to develop iron-deficiency anæmia. Premature infants have a much reduced iron store, and develop nutritional anæmia more easily.

One of the greatest arguments in favour of early mixed feeding is the prevention of iron deficiency anæmias. Egg-yolk contains 6.13 mg. per 100 g. of iron. Vegetables contain variable amounts of iron—most have an average of 0.5–1 mg. per 100 g. The iron of certain vegetables, e.g., spinach (4 mg. per 100g.) is not easily available for the infant.

Nutritional anæmia can also be prevented by adding iron to the milk. Many of the dried milks now have iron salts added to them.

Vitamins

Cow's milk contains sufficient Vitamin 'A' for the requirements of the infant. The amount of Vitamin 'D' in unfortified milk is small. There is much more Riboflavine and slightly more Thiamin in cow's milk than in human milk, but about half the amount of Nicotinic acid. These amounts appear to be sufficient to prevent Vitamin 'B' deficiency diseases. Cow's milk is a much poorer source of Vitamin 'C' than human milk. Moreover it deteriorates if it is kept for long and is partially destroyed by heat. It is essential, therefore, to add Vitamin 'C' and Vitamin 'D' to the diet of infants who are fed on boiled cow's milk or dried and evaporated milks.

Calories

The Calorie value of cow's milk is about 70 per 100 ml. or 20 per oz. It is greater in Jersey and Guernsey milk, due to their higher percentage of fat.

Bacteriology

Milk contains certain enzymes, agglutinins and antitoxins. The bacterial content of fresh milk is diminished in the first hours after milking by the action of these bodies, and some of the immunity to certain infections shown by the newly born may be due to these substances in the milk. Colostrum, owing to its rich globulin content, is thought to be more effective than milk in conveying immunity to the young animal.

Samples of milk collected from the cow's udder show micrococci, streptococci and sometimes B. coli. These organisms, chiefly by their action on the lactose in milk and to a lesser extent by their proteolytic action, are responsible for the souring of milk with the production of acid, gas and clots, such souring being delayed by immediate cooling of the collected samples or by the various means used in 'sterilizing' milk.

Though coliform organisms are not as a rule pathogenic, the quantity present in cow's milk gives a good measure of the extent of contamination.

The sources of contamination during milking are many. One of the most fertile is the cow's coat; dirt drying on this is shed into the milk pail where no precautions are taken to clean the animal before milking; infection also comes from the hands and clothes of the milker, especially when 'wet milking' is used. Stable dirt and lack of cleanliness in the dairy utensils may cause further infection. When the usual methods of transport and retailing of milk are considered, it is not surprising that milk bought in our towns is often heavily infected, even when obtained from a healthy herd in the first place. In the last twenty years there has been a marked improvement in dairy methods, and it is now possible to obtain milk which has been collected from healthy herds under standardized conditions. This will be discussed later, but sufficient has been said to indicate that for practical purposes 'raw' milk should not be given to a baby.

Widespread epidemics have resulted from contaminated milk, such as Typhoid and Scarlet Fever and outbreaks of Epidemic Sore Throat due to haemolytic streptococci. Outbreaks caused by contamination of milk with Salmonella organisms and Sonne Dysentery have been reported. In this connection the possibility of a carrier among the farm workers must be remembered. Perhaps more important than this is the fact that bovine tuberculosis is highly infectious to human beings. Abdominal Tuberculosis in young children is mainly due to the bovine type of tubercle bacillus. Tuberculosis is common among cattle and tubercle bacilli can frequently be demonstrated in samples of milk taken at random from various sources.

Of recent years the importance of undulant fever (infection by *B. Abortis* or *B. Melitensis*) has been emphasized.[1] Out of 147 cases investigated 141 patients were found to have been drinking raw milk, that is cow's milk which had not been boiled or pasteurized. It is claimed that from 20–30 per cent of milk in this country is infected by the organisms of undulant fever. Despite this fact the incidence of human infection is low.

What proportion of cases of infective gastro-enteritis is caused by milk-borne infection is not definitely known. Perhaps some 10 per cent of cases occurring in London may be directly attributable

[1] Champneys, W. D.: *Lancet*, 1934, 1, 96.

to an infected milk, others depending on factors to be mentioned later. The need for clean milk, and for pasteurization or boiling before use, is further emphasized by these facts.

Other milks than that obtained from the cow have been used in the artificial feeding of infants, but they afford no special advantage. Asses' milk is very similar in composition to human milk. Of these, perhaps the commonest used has been goat's milk, which approximates in composition to cow's milk. It is used sometimes in babies who are allergic to cow's milk. It is said that the danger of tuberculosis is less in this animal, but the relation of goat's milk to undulant fever in certain Mediterranean countries must be remembered. Goat's milk is very deficient in Vitamin 'B'.

Graded Milks

Owing to the gross contamination to which so much of our milk is exposed, attempts have been made to put on the market a clean milk which is known to be of a certain standard of purity, such standard conforming to that laid down under the Milk (Special Designations) Order 1936.[1] These are known as:

1. *Tuberculin-Tested Milk* is milk from tubercle-free cows. If it is bottled on the farm, it may be described on the bottle caps or cartons as Tuberculin-tested Milk (Farm-Bottled). If it is pasteurized it is described as Tuberculin-tested Milk (Pasteurized).

2. *Certified Milk* is raw milk from cows which have passed a veterinary examination; it is bottled on the farm or elsewhere. It must satisfy the same bacteriological tests as tuberculin-tested milk.

3. *Pasteurized Milk* is milk which has been heated to a temperature of 145°–150° F. for at least thirty minutes and then cooled to 55° F.

Should Milk be Boiled or Pasteurized?

Cow's milk is boiled for two reasons. First, to render the protein more digestible (see p. 72), and secondly, to kill any bacteria which it may contain. Sufficient has been said in the previous pages to show that milk may become infected with various types of

[1] These were modified by a further Regulation in 1946 abolishing the count standard and substituting a methylene-blue standard, together with a phosphatase standard.

bacteria. The only safeguard, therefore, is to boil all milk given to infants, unless it has been previously pasteurized. Wilson[1] has shown that pasteurization properly carried out will effectively kill tubercle bacilli which are the most resistant organisms. It should be stressed that in most rural areas and in many small towns unpasteurized milk is still sold to the public. Since much of the milk is bulked, the whole supply may be infected by milk from a single farm. Neither pasteurization nor boiling affects the nutritional value of milk, apart from the Vitamin 'C' content, which is largely destroyed by heat treatment (especially by boiling). Boiled milk has, however, an altered taste and is consequently often disliked by children.

In short, milk which has not been boiled or pasteurized should not be given to infants. Unboiled milk may be given to children over one year provided that it is efficiently pasteurized.

EVAPORATED MILKS

In the manufacture of these milks, whole or skimmed milk is sterilized by heat at a temperature of 240° F. after partial removal *in vacuo* of the water. In sweetened condensed milk bacteriological purity is achieved by the addition of cane sugar which checks bacterial growth, and exposure to high temperatures is avoided. Vitamins tend to be affected much more in the unsweetened than in the sweetened condensed milks. The former loses about 60 per cent of the Vitamin 'C' and 30–50 per cent of the Vitamin B1. The loss in sweetened condensed milk is much less.

Sweetened Full-Cream Evaporated Milk

The condensed milks in this group have had sucrose added. Vitamins are entirely or almost entirely conserved, and the product is almost sterile, being free from pathogenic organisms. When diluted in the usual fashion, a drachm to the ounce, for the purposes of infant feeding, both the protein and fat are very low, and the carbohydrate rather on the high side, thus giving a very unbalanced food. The addition of some fat, in the form of cream or cod-liver oil, and a little fresh cow's milk or dried milk makes a more satisfactory food.

[1] Wilson, G. S.: *The Pasteurization of Milk* (Arnold & Co., London, 1942).

Unsweetened Full-Cream Evaporated Milks

These are, on the whole, more useful in infant feeding than the sweetened brands. With a dilution of one part of milk to two parts of water and the addition of sugar (see p. 80), a mixture can be made which is extremely satisfactory in feeding normal infants. Weaker mixtures are necessary for premature and underweight infants. The vitamins are not so well preserved as in the sweetened full-cream milks, and the addition of cod-liver or halibut-liver oil and fruit juice to the diet is therefore essential. The unsweetened milks are extremely digestible and are, therefore, excellent baby foods. It should be noted that once the tin is opened these milks do not keep well.

Table IV gives the better known evaporated milks with their composition.

TABLE IV

SHOWING THE COMPOSITION OF THE BETTER-KNOWN EVAPORATED MILKS

Name of Milk	Caloric Value of 1 oz.	Fat per cent	Protein per cent	Carbo-hydrate per cent	Water per cent
A. Sweetened Full-Cream Evaporated Milks					
Nestlé's	99.0	10.0	9.4	53.0	25.5
Tip-Top Red Butter-fly (Nestlé's) ..	98.0	9.3	8.6	54.5	25.7
Diploma	98.7	9.30	8.55	55.30	25.0
B. Unsweetened Full-Cream Evaporated Milks					
Ideal (Nestlé's) ..	49.0	9.35	8.6	12.4	67.75
Carnation	53.0	9.2	8.36	11.3	69.0
Libby's	53.2	9.25	9.19	11.66	68.0
Regal or Coronet ..	50.0	9.30	9.36	12.08	68.4
Everyday or Green Butterfly	49.0	9.35	8.6	12.4	67.75

DRIED MILKS

The use of these is now so universal that some knowledge of the composition of the more common ones is essential for the doctor interested in infant feeding. Speaking generally, they must never be used as a substitute for breast milk until all efforts have failed to obtain a supply of natural food; they offer some advantage over modified cow's milk in the artificial feeding of the healthy infant, especially in difficult cases, owing to the modification of the protein during their manufacture, to their low fat content in some

cases, or to the substitution of more easily digested carbohydrate in others. National Dried Milk, Half-Cream and Full-Cream, introduced during the war, is now a very popular and satisfactory artificial food for infants. As it is subsidized, its price is low compared with proprietary dried milks.

Dried milks are manufactured in two ways:

1. *Roller Process.* Fresh milk is poured on hot rollers, and the fluid is driven off, whilst solid constituents remain as a fine film on the surface, from which they are scraped off and tinned.

2. *Spray Process.* This dries the hot milk by forcing it through small jets, the fluid portion evaporating away and the dry powder falling to the bottom of the chamber.

One drachm of the dried milk dissolved in eight drachms (1 oz.) of water reconstitutes whole cow's milk, a fact which is often forgotten in infant feeding. Many who would hesitate to prescribe whole milk to a young infant do not realize that the infant on a full-cream dried milk feed, made up of a measure to the ounce of water, is getting a mixture which has the essential constitution of whole milk. Dilution of full-cream dried milks is therefore necessary (see p. 79). Some of the better-known full-cream dried milks are given in Table V, together with their composition.

In Table VI will be found the most commonly used dried milks with a reduced fat content, together with their compositions.

The question whether it is necessary or desirable to *humanize* cow's milk—i.e., to modify the composition of the milk to resemble that of breast milk—will be discussed later. Several dried milks are now sold which, on the addition of 1 drachm of the powder to 1 oz. of water, approximate closely to the composition of breast milk. The common ones are given in Table VII.

Advantages of Dried Milk

The chief advantages of a dried milk lies in the fact that it is a sterile preparation whose composition does not vary. Some of the dried milks are obtained from cattle which are pasture-fed the whole year round, and so give a less variable composition than 'stall-fed' milk.

The effect of heat on the protein in the drying process is to render it more easily digestible so that the size of the clot formed in

the stomach is reduced. A dried milk may, therefore, prove of value in the feeding of a difficult case where the symptoms suggest an inability on the part of the baby to deal with the casein in cow's milk.

TABLE V

COMPOSITION OF THE BETTER-KNOWN FULL-CREAM DRIED MILKS

Name of Dried Milk	Water per cent	Protein per cent	Fat per cent	Carbohydrate per cent	Caloric Value of 1 oz.	Remarks
National Dried Milk Full-Cream		25.6	26.6	36.4	138	No added sugar.
Cow & Gate Full-Cream (Pink Tin)	2.5	26.6	27.3	37.6	146	A pure dried milk. Vitamin D content 250.1.4 per pint. No added sugar.
Ostermilk No. 2 Glaxo	2.8	26.0	26.5	37.5	144	Dried milk with milk-sugar, cream fat, Vitamin D and iron added.
Trufood Full-Cream	1.85	26.5	26.3	39.1	150	Pure dried milk with the addition of lactose.
Dorsella	3.0	27.0	26.05	37.2	150	The same with the addition of iron.
Haemolac (Cow & Gate)	2.45	26.5	27.2	37.5	147	Contains 31½ grains of iron and ammonium citrate per pound of dried milk.
Lacta	3.0	27.0	26.05	37.2	146	Pure dried milk.
Ambrosia Full-Cream	2.56	26.9	26.55	37.95	155	Pure dried milk.

When travelling, when living in the tropics, or when no refrigerator is available, dried milk possesses obvious advantages over ordinary milk, and it is easy to obtain, to keep and to make up as feeds.

It has been suggested that these preparations are deficient in the Vitamins 'A', 'D' and 'C', and so their use may cause rickets and scurvy. It is certain, however, that the destruction of vitamins by drying is not complete, and the danger is easily overcome by

the addition of cod-liver oil or halibut-liver oil, and fruit juice, to the infant's diet. Many dried milks contain a considerable amount of added Vitamin 'D'.

TABLE VI

DRIED MILKS WITH A LOW FAT CONTENT AND THEIR COMPOSITION

Name of Dried Milk	Water per cent	Protein per cent	Fat per cent	Carbo-hydrate per cent	Caloric Value of 1 oz.	Remarks
National Dried Milk Half-Cream		30.1	16.5	41.3	124	No added sugar
Cow & Gate Half-Cream (Blue tin)	2.5	19.5	15.5	57.0	130	A half-cream dried milk modified by the addition of lactose.
Cow & Gate 'special' Half-Cream	2.5	30.3	16.5	43.8	129	No added sugar.
Cow & Gate (skimmed) White Label	3.0	35.5	0.8	52.8	104	Made from separated milk.
Glaxo Ostermilk No. 1	1.9	18.1	19.0	56.0	137	A modified dried milk with added lactose, Vitamin D and iron.
Trufood Half-Cream	2.0	32.0	14.5	54.4	126	
Trufood (Skimmed)	2.8	34.0	1.1	54.85	109	
Secway	1.0	13.0	1.0	75.0	105	Dried whey.
Frailac (Cow & Gate)	1.7	11.5	12.0	55.3	128.	For premature and under - weight infants.

ARTIFICIAL FEEDING IN THE TROPICS

On the whole, dried milk is preferable. The elements of the diet which the infant does not readily tolerate under these climatic conditions are (1) fat and (2) sugar. This fact has been noted by commercial firms, and they have, therefore, manufactured a special brand for export to tropical countries. In looking at the analyses, it will be seen that they are lower in fat content than the usual brand. Less sugar is required in these warm climates than would be required with a higher fat content in the brands sold for use in the British Isles. Among those firms manufacturing a special

TABLE VII

THE COMMONER 'HUMANIZED' DRIED MILKS AND THEIR COMPOSITION

Name of Dried Milk	Water per cent	Protein per cent	Fat per cent	Carbohydrate per cent	Caloric Value of 1 oz.	Remarks
Cow & Gate Humanized	2.5	15.5	26.0	52.0	147	A roller milk powder humanized by the addition of milk and lactose.
Lactogen (Nestlé's)	2.0	16.2	25.0	53.3	147	A dried milk, the protein content of which has been reduced by the addition of cream and lactose.
Humanized Trufood	2.0	14.4	27.3	49.65	144	Dried milk in which the ratio of the proteins has been adjusted in the breast milk standard with the addition of lecithin and other necessary ingredients.
Humanized Dorsella	2.9	12.38	25.93	55.62	150	
Modilac (Cow & Gate)	2.0	18.6	19.0	56.3	136	A full-cream powder containing dextrose and dextrin.

export or tropical food are the makers of Glaxo, the analysis of which appears below, but any of the dried milks with a low fat content, as given in Table VI, would be suitable for use in the tropics. Some firms, such as the makers of Lactogen, pack their product specially for export, and they are, therefore, widely popular in the tropics.

Glaxo (Tropical)

Moisture	2.5 per cent
Fat	20.0 „
Carbohydrate	46.0 „
Protein	24.5 „
Ash	5.5 „

Calorie value of 1 oz.=135.

STARCHY PROPRIETARY FOODS

Apart from the preparations already discussed under the headings of dried milks and their modifications, many starchy foods are now offered as additions to cow's milk in the artificial feeding of infants. The following are some of the common ones in use in this country, the analyses having been obtained from various sources, mainly from the manufacturers themselves. *It must be understood that the analyses represent the dried preparation which, when made up by the addition of milk and water, is modified so that the excess of sugar and starch is not so marked.*

The protein (P), fat (F) and carbohydrate (C) only are mentioned in percentages, the ash content and moisture supplying the remaining figures.

When a proprietary food is used the greatest care must be taken that it is not given in excess. If the proportion of starch is too high a pale, flabby infant results, with a low resistance to infection. Many of the proprietary foods are deficient in vitamins, and therefore cod-liver oil and fruit juice should invariably be added. The baby who will not tolerate sugar when this is given as cane sugar or lactose, will often take an adequate amount of dextrins and maltose (partly digested starch), or again may fail to gain weight on simple milk mixtures and will thrive at once when some starchy food is added to the diet. At the period of weaning, a proprietary food may initiate with success the first attempt to give other than milk. In later chapters we shall indicate the difficult cases of feeding which may be expected to improve with the addition of starchy preparations.

Here follows a list of proprietary foods with their composition.

Arrowroot. (P.), 0.1; (F.), 0.02; (C.), 84.45. Made from the starch of the root of a West Indian plant. (*Maranta arundinacea.*) Calorie value of 1 oz.=101.

Benger's Food. (P.), 9.5–10.5; (F.), 1.0–1.5; (C.), 83.0. A mixture of wheat flour and pancreatic extract. When prepared according to the directions, most, but not all, of the starch is converted into soluble forms. The protein is also partially digested as well as that of the milk used in mixing it. One tablespoonful (about 1 oz.) and four tablespoonfuls of cold milk, then add ½ pint of boiling milk

and water; set aside in a warm place for fifteen minutes, then bring to the boil. Calorie value of 1 oz.=113.

Cerex. (Cow & Gate). (P.), 11.3; (F.), 1.0; (C.), 77.1. Made from malted wheat flour with added Vitamins 'A' and 'D'. Calorie value of 1 oz.=112.

Chapman's Entire Wheat Food. (P.), 12.8; (F.), 2.1; (C.), 71.7. This food is a specially processed wheatmeal preparation containing the natural element of entire wheat. A special baking process of the product renders the product easily digestible and makes the nutritious elements naturally present in the wheat grain easily assimilable to the infant. Calorie value of 1 oz.=112.

Chapman's Whole Wheat Flour. (P.), 9.4; (F.), 2.0; (C.), 79.3. A finely-ground wholemeal flour. Not much superior in nutritive value to the ordinary 'household' flour. Starch entirely unaltered. Calorie value of 1 oz.=112.

Cream of Wheat. (P.), 11.81; (F.), 2.40; (C.), 72.46. Made from the granulated endosperm, or kernel of wheat. Calorie value of 1 oz.=108.

Daltose. (Cow & Gate). A mixture of carbohydrate containing maltose and dextrose, etc. Its composition per cent is: moisture 5.0, maltose and dextrose 55, dextrins 36, calcium lactate 2.0, Vitamin 'D' 2,000 international units per pound.

Farex. (Glaxo). (P.), 13.4; (F.), 2.3; (C.), 73.5. A preparation requiring no cooking, containing wheat flour 53 per cent, Midlothian oat flour 18 per cent, maize flour 10 per cent, wheat germ 15 per cent, dried yeast, bone meal, and vitamin concentrates; the whole mixture being subjected to a 'solubilizing' process to increase digestibility of the contents. Calorie value of 1 oz.=110.

Floured Rice. (P.), 6.9; (F.), 0.3; (C.), 80.0. This is a patent food containing a high proportion of starch. Calorie value of 1 oz.=105.

Mellin's Food. (Mellin's Malto-Dextrin Food). (P.), 6.15; (F.), 0.06; (C.), 14.29. This is a carefully-balanced mixture of predigested sugars and semi-digested sugars.

M.O.F. (*Midlothian Oat Food*) (Scott's). (P.), 9.7; (F.); 5.0. (C.), 78.2. A fine oat flour intended to be added to a milk mixture and requires one minute's cooking only. Fortified with calcium, phosphates, iron and Vitamin 'D' in proper proportions. Calorie value of 1 oz.=118.

Ovaltine. (P.), 11.7; (F.), 6.5; (C.), 76.2. A readily-soluble easily-digestible granulated concentrate of malt, milk, cocoa, soya and eggs. Contains neither starch nor husks of grain. Calorie value of 1 oz.=119.

Pablum. (P.), 14.8; (F.), 3.00; (C.), 71.4. Composed of wheatmeal, cornmeal, rolled oats, wheat-germ, alfalfa, yeast and edible bone-meal. Calorie value of 1 oz.=120.

Prosol. (Trufood). (P.), 63.0; (F.), 1.0; (C.), 26.2. Prosol affords an ideal source of protein for children. It contains milk proteins in a concentrated and easily digestible form. In contrast with most preparations of high protein content, Prosol is palatable and in no way nauseating during the phase of digestion. Calorie value of 1 oz.=107.

Ridge's Food. (P.), 12.13; (F.), 2.71; (C.), 79.72. A baked flour containing only 3 per cent of soluble carbohydrate, the remainder being starch. Recommended to be made with milk and water. Calorie value of 1 oz.=116.

Robinson's Patent Barley. (P.), 7.0; (F.), 1.0; (C.), 81.0. Ground pearl barley, poor in every element except starch and mineral matter. Calorie value of 1 oz.=105.

Robinson's Patent Groats. (P.), 12.3; (F.), 7.3; (C.), 68.3. Ground oats from which the husk has been removed. Rich in protein and mineral matter. Calorie value of 1 oz.=114.

Robrex. (P.), 12.0; (F.), 3.7; (C.), 74.0. Made from wheat flour, oat flour, barley flour, malt extract, dried yeast, calcium phosphate, iron, calciferol, and aneurine. Calorie value of 1 oz.=110.

Ryvita. (P.), 11.6; (F.), 1.3; (C.), 74.8. Made in England from crushed whole rye grain. Calorie value of 1 oz.=104.

Savory and Moore's Food. (P.), 12.6; (F.), 1.5; (C.), 76.8. Composed of wheat flour with the addition of malt and diastase. When prepared according to the directions, most, but not all, of the starch is converted into soluble forms (chiefly maltose and malto-dextrins). One or two tablespoonfuls (equals from 1–2 oz.) to be mixed with two or three tablespoonfuls of cold milk or milk and water, and $\frac{1}{3}$ pint of boiling milk and water to be added. Calorie value of 1 oz.=111.

Scott's Baby Cereal. Oat. (P.), 11.2; (F.), 6.2; (C.), 72.3. This consists of oat flour, malt extract, bone phosphate, dried yeast, iron

and ammonium citrate, manganese sulphate, copper sulphate and calciferol. Calorie value of 1 oz.=114.

Wheat. (P.), 11.2; (F.), 6.2; (C.), 72.3. This consists of wheat flour, malt extract, wheat germ, bone phosphate, calcium carbonate, dried yeast, iron and ammonium citrate, manganese sulphate, copper sulphate, and calciferol. Calorie value of 1 oz.=106.

Sister Laura's Food. (P.), 20.96; (F.), 2.94; (C.), 75.27. A food prepared from wheat starch, intended to be added to undiluted milk. Calorie value of 1 oz.=123.

Soya Bean Flour. (P.), 40.65; (F.), 20.38; (C.), 23.56. A flour with a very high food value, especially protein, and a high vitamin content, made from the soya bean. Calorie value of 1 oz.=124.

Trufood Cereal Food. (P.), 21.4; (F.), 5.4; (C.), 60.7. This food is made from skimmed milk, oat flour, dried yeast, salt, dicalcium phosphate, calciferol, nicotinic acid and aneurine. Calorie value of 1 oz.=110.

Veguva. (P.), 9.63; (F.), 2.90; (C.), 77.24. A dried mixture of spinach, carrots and tomatoes, rich in Vitamins 'A', 'B', and 'C', (the latter not destroyed by drying). The vehicle used is a mixture of starch and its various cleavage products obtained by diastatic disintegration. To be used as a substitute for home-made vegetable broth. Calorie value of 1 oz.=112.

Virol. (P.), 7.50; (F.), 11.60; (C.), 56.33. Composed of marrow fat, glycerine, extract of red bone marrow, eggs, salts of lime, etc., malt extract, and the juice of fresh lemons.

Vita Wheat. (P.), 11.52; (F.), 7.66; (C.), 74.77. Made in England from whole wheat. Calorie value of 1 oz.=127.

CHAPTER FOUR

ARTIFICIAL FEEDING

'THE ESSENTIAL problem of the whole of artificial feeding is to modify cow's milk so that the infant will thrive on it as well as it does on breast milk.' (Brennemann.)[1] This is not accomplished necessarily by making cow's milk approximate to breast milk in its composition, but the aim is to make it serve as adequately as the mother's milk.

There are certain fundamental differences between cow's milk and breast milk which can never quite be overcome. Breast milk is fed directly to the infant, warm and for all practical purposes sterile, and in the quantity demanded by the infant. If the child demands more, the breast is more completely emptied and more is supplied, and if less is demanded the reverse occurs.

In artificial feeding, on the other hand, many hours elapse between the drawing of the milk and its being fed to the infant. During this time milk must be cooled or boiled to preserve it. It is no longer sterile and in many cases teems with bacteria; its casein and fat are relatively difficult to digest, and lastly, it is supplied to the infant in quantities determined by maternal calculation and not by the infant himself.

The question arises in artificial feeding as to whether it is essential to modify the composition of cow's milk to make it as near breast milk as possible. The primary aim is that the artificial food should be metabolized as efficiently by the infant as breast milk, and this can be accomplished by giving a food quite different in proportions to that of breast milk. It is the casein and fat in cow's milk which tend to cause indigestion, the former being particularly liable to give rise to digestive difficulty because of the formation of hard curds in the stomach. These curds can, however, be modified by various methods.

Experience has shown that infants will thrive on cow's milk to which sugar has been added and that complex modifications of cow's milk to bring it closer to the constitution of human milk

[1] Brennemann, J.: *Abt's Pædiatrics*, Vol. II, p. 633.

are quite unnecessary. The cow's milk may be given in the liquid state or in the form of dried or evaporated milk.

CLINICAL IMPORTANCE OF FOOD ELEMENTS

The Fat

No definite amount of fat is necessary for the infant. Fats are less easily absorbed and digested by infants than proteins and carbohydrates. The emulsion of the fat of cow's milk is less complete in human milk, and its globules are in consequence much larger. According to Marriott[1] the physical state is of little importance in fat digestion. Homogenization splits up the fat into much smaller particles. Cow's milk contains a much greater proportion of the lower fatty acids which, in certain conditions, such as infections, are liable to cause diarrhœa.

The fat of cow's milk is not quite so well utilized as that of human milk, as more is converted into relatively insoluble calcium soaps because of the larger proportion of calcium (which is combined with casein), in cow's milk. Because of this excess of calcium soaps, overfeeding with fat generally results in constipation; the stools being pale grey, formed and crumbly. If there is less protein but more carbohydrate in the diet excess of fat leads to diarrhœa. It has been shown that excess of fat in the diet delays the emptying of the stomach.

Because of these facts, too high a proportion of fat should not be given to artificially-fed infants. The high-fat milks, such as that obtained from Jersey and Guernsey cows (whose milk may contain over 5 per cent of fat) should be avoided. Milks containing 3.5–4 per cent of fat are satisfactory. Diets containing a low proportion of fat are required in premature infants and those suffering from gastro-intestinal infections.

Normal healthy infants should not, however, be given diets containing too small a quantity of fat. Fat is a very valuable source of energy; it provides 40 per cent of the calories in the average diet. If given in insufficient amounts it must be replaced by larger amounts of carbohydrates and protein to make up the calories, with the attendant disadvantages. Half-cream mixtures should not

[1] *Infant Nutrition.* Marriott & Jeans. 4th ed., 1947. Henry Kimpton, London.

be given for longer than the first few weeks. Most babies are able to digest full-cream milk when they reach a weight of 10 lb.

The Proteins

The protein requirements of the normal bottle-fed infant are approximately 3.5 grams for each kilogram of body weight, (or 1.7 G. per pound) as compared with 2 G. per kilogram (1 G. per pound) in the breast-fed infant. These requirements are met if the infant receives approximately 1½–2 oz. per pound of body weight in the case of cow's milk, and 2½–3 oz. per pound of body weight in the case of breast milk. These figures are somewhat arbitrary, as it is difficult to estimate the optimum protein requirements. In young infants, about 70–80 per cent of the protein is converted into body tissues. The infant is, therefore, in a state of positive nitrogen balance. When the protein content of the diet is insufficient, the baby gains weight slowly, there is a decreased resistance to infection and the muscles become flabby. Severe protein undernourishment over a long period will result in a fall of serum protein, generalized nutritional oedema and fatty changes in the liver. Premature infants require more protein than is present in human milk, and extra protein must be added. A moderate excess of protein is not harmful, but when a considerable excess is given, the infant vomits large, hard curds, becomes constipated (the stools containing large, pale, non-greasy curds), and may show symptoms of dehydration. Such symptoms may appear if infants are fed on whole milk mixtures with added protein, or on undiluted evaporated milk or concentrated dried milk.

The protein of cow's milk is largely made up of casein (85 per cent). There is no difficulty in digesting the lactalbumen and lactoglobulin. The casein, when acted upon by acid and rennet, coagulates with the production of hard curds. This is seen, of course, in the making of whey or junket. The breast-fed infant who vomits some time after food brings up soft fine curds because of the small proportion of casein in breast milk. The bottle-fed baby on the other hand, brings up large, hard curds, especially if the feed is one of unboiled milk.

Spur and Wolman[1] have recently studied the curd-forming

[1] Spur, B. and Wolman, I. J.: *Journ. Pæd.*, 1952, 41, 541.

properties of milk mixtures used in infant feeding, using a special method for measuring curd tension, and a technique for measuring the size pattern of curds.

They found that unmodified pasteurized milk tends to be slightly less 'hard-curd' than unprocessed, raw milk. On the other hand, they found that boiling of milk, dilution with water, acidification and homogenization effectively eliminates the tendency of unmodified cow's milk to form firm coagula in the stomach. Milk, when raised to boiling point, became soft curd immediately. Further boiling induced little additional change, even after thirty minutes. Lime water had no effect on curd formation. Fever aggravates the tendency to hard curd formation. Modification of the curd formation may therefore be produced:

1. By bringing milk to the boil in a double saucepan. Prolonged boiling is unnecessary, besides destroying the vitamins present.

2. By the use of other forms of heat treatment as used in the preparation of dried and evaporated milks.

3. By dilution (*a*) with plain water or (*b*) with cereal waters, e.g., barley or oat water. According to Spur the soft curd limit is not reached until the dilution has reached 35 per cent water added to milk.

4. By acidification with lactic and hydrochloric acids or by addition of a lactic-acid producing organism such as *Lactobacillus Acidophilus* and *Lactobacillus Bulgaricus*.

5. By homogenization of milk. This process consists in forcing milk through minute openings in a metal plate at high pressure. Besides producing a soft curd, homogenization breaks up the fat globules into very small particles.

6. Peptonization. This is not strictly a curd-modification, since it consists of a partial pre-digestion of the casein, usually by means of pancreatic ferment. It is complicated and expensive, and is not necessary for the modification of cow's milk in feeding healthy infants. The subject of peptonization will be dealt with later in the chapter.

The Carbohydrate

Sugar. Lactose or milk sugar is the only carbohydrate present in human or cow's milk. In the practical feeding of children, sugar is

essential if the infant is to gain weight. Carbohydrate is the most readily available source of energy, and can partially replace protein or fat. It cannot, of course, entirely replace protein, since some essential amino-acids are necessary for the building of body tissue. An infant requires daily not less than 1 per cent of its body weight in carbohydrate (approximately 1/7 oz. for each pound of body weight) which approximately equals 1 drachm per pound of body weight. This amount is present in breast milk, but owing to the lower proportion of sugar in cow's milk, extra sugar must be added.

It will be found, however, that few infants can take more than 2 oz. (eight heaped or sixteen level teaspoonsful) of added sugar in 24 hours.

The symptoms of sugar intolerance are the passage of frequent frothy, acid, scalding stools which rapidly excoriate the buttocks. This indicates an active fermentation of sugar by the bacteria in the intestines.

As previously mentioned, artificially-fed infants tend to be constipated, and the symptom is usually relieved by the addition of sugar to the diet.

The question is often asked 'Is it necessary to use a special type of sugar in the artificial feeding of infants?' We think that for a healthy infant it is not necessary to employ a special sugar; in fact, the ordinary household granulated or brown sugar may be given. Lactose or milk sugar has no special value when added to the feed, and is easily fermented by the intestinal bacteria.

The Polysaccharides, e.g., Lactose, Sucrose, are digested in the upper part of the intestinal tract, and the greater part is absorbed in the lower ileum. This delay in absorption allows some fermentation to take place. Excess of these two sugars, therefore, tends to produce diarrhœa. Monosaccharides such as Glucose are absorbed from the upper small intestine, and there is consequently less opportunity for fermentation. As a general rule, total sugar concentrations of more than 8 per cent should not be given.

Some infants are prone to loose stools, and do not seem to be able to tolerate sugar well. In these a dextri-maltose preparation may be given, e.g., Mead's dextri-maltose, Mellin's food, Karolac, etc. These are usually prepared by the action of amylase on cereal

starch. They contain varying proportions of dextrose and maltose, and are much better tolerated than simple sugars, and so can be given in larger amounts without producing diarrhœa.

Starch. Starch is the chief constituent of all cereal grains. It occurs in small granules with an envelope of cellulose, which is very difficult to digest—cooking ruptures the cellulose envelopes and liberates the starch. The starch is broken down by the amylase of the pancreatic juice into dextrins and maltose and finally into dextrose. The process of starch digestion is thus slower than that of sugar.

Starch is not well digested by the very young infant, though a tolerance to starch does gradually develop. It is probably better to give dextri-maltose preparations rather than starch before the age of two to three months.

Starch preparations are also useful for thickening the feeds in infants who vomit easily, as in rumination and habit vomiting.

Salts

The mineral requirements are discussed in Chapter Three.

Calories

The calorie is a measure of energy expressed as heat. When food is utilized in the body as fuel, the energy derived from it is ultimately given off in the form of heat. The energy provided by food is used for the vital activities of the heart, lungs, muscles and digestive organs.

Foods vary in their fuel value. This can be estimated by burning the food in a watertight metal container in the presence of oxygen under pressure to ensure that complete combustion takes place.

The fuel value of fat when burned in the body is slightly over 9 calories per gram, and that of protein and carbohydrate about 4 calories per gram.

The total energy requirements are made up of:

(*a*) *The Basal Metabolism*, i.e., the output when at complete rest.

(*b*) *Specific Dynamic Action* of food. The utilization of food in itself causes some increase in heat output. This effect is most marked in the case of protein.

(*c*) *Allowance for Activity*. This varies with the individual infant.

(*d*) *Allowance for Growth*, i.e., for the building up of new tissue. If a baby is undernourished, the calorie growth requirements are much above the average.

(*e*) *Allowance for Un-utilized Food.*

The total daily calorie requirements of the average normal infant during the first year of life are 50–52 per pound, made up of 25 per pound for basal metabolism, 4 per pound for specific dynamic action, 10 per pound for activity, 7 per pound for growth, and 6 per pound for unutilized food.

The calorie requirements during the first year vary considerably. For the first two or three weeks, they are low. By the end of the first month, they have risen to 55–60 per pound. There is a gradual fall from the sixth month to 50 calories per pound at the end of the first year.

The calorie requirements are met in the case of a breast-fed infant if he receives daily 3 oz. of milk for each pound of body weight. In the case of a bottle-fed infant approximately two-thirds of the total calorie requirements should be met by milk and one-third by added carbohydrate. 3 oz. of such a mixture should be given daily for each pound of body weight.

Unless these energy requirements are met, the infant will fail to gain weight even though the food is easily digestible.

In the case of underweight infants, the calorie intake for the actual weight must be much higher than a normal baby of the same weight. Calculation of the required calorie intake must, therefore, be made by reference to the expected weight. Premature infants after the first two weeks also need a high calorie intake.

On the other hand, the overweight infant does not require much more food than the infant of the same age who is of average weight.

Water

The normal healthy infant requires about 3 oz. of fluid per pound of body weight daily. Most of this he obtains in the form of milk and the remainder must be given in added water. In summer time more water is necessary, because of loss of fluid in the sweat. If an adequate amount of water is not given to a child he tends to become constipated and to pass only a small quantity of highly concentrated urine which stains the napkins.

In marked cases of dehydration the infant almost invariably runs a temperature, the fontanelle is sunken and the skin inelastic.

As a cure for constipation in breast-fed babies, additional water is useful. Feverish and infants with acute diarrhœa and vomiting all require additional water. Water with a small amount of salt ($\frac{1}{2}$ drachm to the ounce), that is half-normal strength saline, when given by the mouth is rapidly absorbed and retained.

METHODS OF ARTIFICIAL FEEDING

Many methods of artificial feeding have been advocated in the past but to-day the emphasis is on simplicity. Complicated formulæ have been found to be unnecessary. Babies will thrive on feeds of varying composition, whether prepared from liquid milk, dried milk, or evaporated milk, providing that certain essential requirements are satisfied.

The infant's food must be easily digestible, be free of harmful bacteria, contain sufficient protein, fat, carbohydrate, mineral salts, vitamins and water. It must also have an adequate calorie value.

If a baby does not thrive on a sufficient amount of an adequately balanced diet, one should consider the possibility of an infection or other organic disease. (See Chapter VIII).

The easiest way to approach the subject of infant feeding is for the doctor to think in terms of milk, raw, dried or evaporated, and the sugar required by the infant in the twenty-four hours rather than to think of percentages of the different food elements.

Individual babies vary in their food requirements, although of the same weight; nevertheless, the expected weight of an infant is the most valuable guide in prescribing a feed, and is certainly of more help than the age. If the weight of the new-born infant were considered rather than its age, the old saying 'the little baby thrives better than the big one' would probably never be heard. The fatter and more above average weight the infant is, the less food he requires per pound of body weight per day. Some infants are active, cry a lot and require more food to make them thrive. Others sleep well, do not show much activity, and will thrive on lesser quantities. In warm weather all infants require less food than in a cold stimulating climate.

The individual infant, then, must be studied and no rule can ever be made absolutely applicable to all infants. It cannot be too strongly emphasized that the baby itself is the final judge of the adequacy or not of its feeds. Some indication, however, may be gained of the food requirements in the twenty-four hours by considering the quantity upon which a normal healthy infant will thrive and expressing it in terms of the amounts necessary for each pound weight of the infant.

Expected Weight

The expected weight of an infant is much more helpful in calculating its feed requirements than is its age, and is the most useful basis of calculation we have at present. A very good rule to go by is that an infant should gain an ounce a day for ninety days, except in the first ten days of his life. During the first ten days, an infant usually loses an ounce a day for the first five days and then regains this lost 5 oz. in the next five days. Thus, by the tenth day, the infant has regained his birth weight. Then for the next ninety days he gains 1 oz. per day. At the end of three months he should gain 1 lb. per month up to the age of one year.

Example

Birth Weight: 8 lb. 10 oz.
Age: 12 weeks or 84 days.
Therefore add 84 oz. less 10 oz.=74 oz. or 4 lb. 10 oz.
Expected Weight=8 lb. 10 oz.+4 lb. 10 oz.=13 lb. 4 oz.

Many infants gain at a more rapid rate. This does not indicate overfeeding.

Food Requirements

A thriving baby fed on the breast obtains approximately 3 oz. of breast milk per pound of body weight daily. This must be taken as a standard when making up any artificial food. Thus a 7 lb. baby should be given 3 oz.×7=21 oz. of milk mixture and a 12 lb. baby 3 oz.×12=36 oz. of milk mixture in twenty-four hours. Thus daily food requirements (in ounces) for a healthy infant are calculated by multiplying the expected weight (in pounds) by three. The calorie requirements of the infant will be met if 3 oz. per pound of body weight daily of any of the following formulæ are given.

Cow's Milk and Water with the Addition of Carbohydrate (sugar)

An analysis of a large number of normal infants' feeds has shown that the baby will thrive well if the basis of its feeds consists of an average of 2 oz. of cow's milk, and a drachm or level teaspoonful of sugar per pound of expected weight per day, water being added to make up a volume of 3 oz.

The most simple method of making up this type of formula is to give the infant 3 oz. per pound of weight per day of a mixture comprising two parts of milk to one part of water, with a level teaspoonful of sugar added for each pound of body weight per day. (See Table VIII.)

Examples

1. Weight of baby .. .. .. 8 lb.
   Fluid requirements daily (8 × 3) .. 24 oz.
   Make up a mixture containing:
   Milk .. .. 16 oz.
   Water .. .. 8 oz.
   Total Fluid .. .. 24 oz.
   Sugar: 8 level teaspoonfuls.
   Give 5 oz. of this mixture four-hourly.

2. Weight of baby .. .. .. 10 lb.
   Fluid requirements daily (10 × 3) .. 30 oz.
   Make up a mixture containing:
   Milk .. .. 20 oz.
   Water .. .. 10 oz.
   Total fluid .. .. 30 oz.
   Sugar: 10 level teaspoonfuls.
   Give 6 oz. of this mixture four-hourly.

It is easiest to make up the daily food requirements and keep in a refrigerator or a cool place, than to make up each feed separately.

In the first week of life infants may require a weaker formula, viz., equal parts of milk and water. Most infants after they reach the weight of 12 lb., require a stronger formula, viz., three parts of milk to one of water. The transition from the weaker to the stronger formula can be made gradually by increasing the milk and decreasing the water in the mixture. Infants six to seven months old can digest whole boiled milk.

DRIED MILKS

Milks with Low Fat-Content

(Half-Cream National Dried Milk, Half-Cream Cow & Gate, Ostermilk No. 1, Half-Cream Trufood.) These milks contain

about 15 per cent of fat (dry weight) except Ostermilk No. 1 (19 per cent) and are suitable for the feeding of infants up to six to eight weeks of age. One level measure or heaped teaspoonful of the powder dissolved in 1 oz. (two tablespoonfuls) of water reconstitutes 1 oz. of liquid milk. 3 oz. of the mixture should be given for each pound of weight per day. Thus a 10 lb. baby would need 30 drachms of dried milk, added to 30 oz. of water daily. 6 oz. of this mixture should be given four-hourly (or 6 drachms to 6 oz. of water five times daily). Some half-cream milks such as Half-Cream Cow & Gate, have had sugar added. Others, e.g., Half-Cream National Dried Milk, need to have sugar added—1 level teaspoonful (1 drachm) for each pound of weight daily. (See Table IX.)

A change from half-cream to full-cream milk should normally be made at a weight of 10 lb. The change should be made gradually. This can be done by substituting in each feed a full-cream measure for a half-cream one every second day, until the complete full-cream formula has been reached. Sugar will have to be added in the usual amounts.

Full Cream Milks

(Cow & Gate, National Dried Milk, Ostermilk No. 2, Ambrosia, Dorsella, etc.) One measure or heaped teaspoonful of a full-cream milk dissolved in 1 oz. (two tablespoonfuls) of water reconstitutes 1 oz. of liquid milk. The amount of full-cream dried milk necessary for normal progress is on the average $2\frac{1}{4}$ drachms per pound of weight daily. One level teaspoonful (one drachm) of sugar must be added for each pound of weight daily. The fluid requirements are worked out as already given (i.e. 3 oz. per pound of weight daily) and the amount of milk dissolved in this.

Example

Weight of infant	11 lb.
Dried milk	25 drachms (measures)
Water	33 oz.
Sugar	11 level teaspoonfuls
Give five feeds of $6\frac{1}{2}$ oz.	

When feeds are made up separately, these measurements become very difficult, and round figures may be used. Thus an 11 lb. baby may be given five measures added to $6\frac{1}{2}$ oz. of water per feed etc. (See Table X.)

Humanized Dried Milks

(Humanized Trufood, Humanized Cow & Gate, Lactogen.) These milks have had their composition adjusted by the addition of lactose, and in some cases cream, so as to approximate to the composition of human milk. In Humanized Trufood the proteins have been adjusted to the human milk standard.

The advantages of Humanized Milks over ordinary full-cream milks is doubtful. These latter are perfectly well digested by most infants who will thrive on them if given adequate amounts.

One heaped teaspoonful (1 drachm) or one measure, when dissolved in 1 oz. of water gives a mixture whose composition approximates to that of breast milk. Three measures of humanized milk should be given for each pound of expected weight, and should be dissolved in the amount of fluid necessary to give 3 oz. for each pound of body weight in twenty-four hours. An 8 lb. baby would be given daily $8 \times 3 = 24$ heaped teaspoonfuls of the powder dissolved in $8 \times 3 = 24$ oz. of water (5 oz. every four hours). No sugar is added. (See Table XII.)

Evaporated Milk

(Libby's, Ideal, Carnation.) These unsweetened evaporated milks are normally made up by adding 1 oz. of milk to 2 oz. of water. 3 oz. of the mixture and one level teaspoon (1 drachm) are given for each pound of weight daily. For older babies stronger mixtures may be given. (See Table XI.)

Summary of Method of Food Calculation

This method may be summarized by stating that for each pound of body weight a normal infant requires on the average:

1. Cow's milk 2 oz. with 1 drachm (one level teaspoonful) of sugar; or
2. Dried milk (full-cream) $2\frac{1}{4}$ drachms ($2\frac{1}{4}$ measures) with 1 drachm (one level teaspoonful) of sugar; or
3. Dried milk (Humanized) 3 drachms, and no added sugar. Any of these must be made up with water to give the child a total amount of fluid corresponding to 3 oz. for each pound of weight in twenty-four hours.

4. Unsweetened evaporated milk, 3 oz. of the evaporated milk mixture (p. 80) for each pound of weight per day.

It will be seen that, throughout the weight of the child has been used in estimating the amount of food required. The whole régime has been based on the average results obtained by watching a large series of cases. The amounts given above are those on which healthy infants have been found to thrive well.

OTHER METHODS OF MODIFYING COW'S MILK

The methods already mentioned are in common use in feeding the well infant. Certain further modifications of cow's milk may also be used, but are essentially applicable to the feeding of ill infants, particularly those with digestive upsets, such as described in Chapter Seven.

Lactic Acid Milk

The incubation of milk, to which has been added a culture of the lactic acid bacillus, for from six to twelve hours at 55° F. raises the acidity of the milk by fermenting the lactose. The effect of an increase in the acidity renders less hydrochloric acid necessary for the digestion of such milk in the stomach. Acidification of milk modifies to a marked extent the hard curd property of casein. This food is useful in:

1. *Premature Infants.* It is claimed by some that lactic acid milk is the most efficient artificial food for prematurity when no breast milk is available.

2. *Fermentative Diarrhœa.* The symptoms of this condition are given on p. 114. The high protein and low sugar composition of lactic acid milk prevent to some extent, fermentation in the intestine. It is a very useful food in the treatment of gastro-enteritis.

A Simple Method of Preparation. The use of cultures of lactic acid bacilli render this method somewhat unpractical except in children's hospitals, but it has recently been shown that lactic acid milk may easily be prepared by the simple addition of the acid to sterilized milk.

The method now adopted is to take 1 pint of skimmed cow's milk, which has been boiled and allowed to cool, and to add to this up to forty-five drops of lactic acid (B.P.) drop by drop,

stirring well all the time. Sugar is added, and the mixture may be given in full strength or after dilution. It must not be warmed to more than blood heat before being given to the infant, however, or it will curdle.

During the summer weather, and especially if there is a long interval between the production of the milk and the receipt by the consumer, the natural acidity of the milk increases. Because of this the full quantity of lactic acid cannot be added to the milk without curdling, in fact, sometimes less than one-half or even one-quarter will turn the milk sour. It is because of this that *up to* forty-five drops per pint is suggested.

It is more convenient to use dried lactic acid milk preparations, the best known of which are 'Lacidac', made by the Cow & Gate manufacturers (The West Surrey Central Dairy Co., Guildford). Skimmed, Half-Cream and Full-Cream milks are available.

	Lacidac (Cow & Gate)		
	Full-Cream	Half-Cream	Separated
	Per cent	Per cent	Per cent
Fat	26.5	16.0	0.7
Protein	25.1	29.3	34.9
Lactose	36.4	42.2	50.4
Mineral matter ..	6.0	6.5	7.5
Water	2.5	2.5	3.0
Free Lactic acid ..	3.5	3.5	3.5
	Per Ounce	Per Ounce	Per Ounce
Calorie value ..	141	124	101

Hydrochloric Acid Milk

In the treatment of infants with eczema or other forms of allergic diathesis, hydrochloric acid milk is considered to be of use. The method of preparation is as follows:

1. The milk is boiled, cooled and the skin removed. This skin is said to consist largely of lactalbumen, which has been held to be the constituent in milk responsible for the allergic phenomena.

2. Place in the bottle the required amount of the milk, add water and sugar to complete the feed, and warm to a suitable temperature.

3. Now add, drop by drop, from one-and-a-half to two drops of

dilute hydrochloric acid (B.P.) per ounce of cow's milk in the feed, as described under Lactic Acid Milk.

4. Do not warm further, but feed directly to the infant.

Allergilac made by Cow & Gate is a dried milk containing the necessary amount of lactic acid, and the lactalbumen removed. This is claimed to be suitable in allergic conditions in infancy and childhood. The formula is:

Fat, 18.0 per cent; casein, 24.8 per cent; lactalbumen, 1.0 per cent; ash, 6.7 per cent; lactose, 43.5 per cent; lactic acid, 2.7 per cent; moisture, 3.0 per cent; acidity value 27°pH value; calorie value=131.

Buttermilk

In the British Isles buttermilk is not widely used, but both on the Continent and in America it is more easily obtainable, and its value is generally recognized. Buttermilk is that fluid which is left after the fat has been removed from the cream by churning in the manufacture of butter, and its sourness is due to the presence of lactic acid. Its composition is approximately $2\frac{1}{2}$–3 per cent of protein, 0.5 per cent of fat, and 3–$4\frac{1}{2}$ per cent of carbohydrate. Its chief uses are in the diarrhœal diseases of infants, especially in those cases where fermentation has been marked. A very excellent dried brand, 'Eledon' is prepared by Nestlé. This is a half-skimmed fresh milk inoculated with lactic acid organisms, and after acidification has proceeded to the desired degree, it is dried by the spray process. The composition of the dry powder is as follows: butterfat, 14 per cent; protein, 30 per cent; lactose, 39 per cent; mineral matter, 7 per cent; lactic acid, 6 per cent; residual moisture, 4 per cent; 1 oz. of 'Eledon' yields 124 calories. For general use the dilution recommended is one part of 'Eledon' in ten parts of water, and the metal measure enclosed with each tin holds $\frac{2}{5}$ oz. of 'Eledon', which is sufficient to prepare four fluid ounces of acid buttermilk.

Protein Milks

These are not used very much now. They are sometimes employed in feeding babies recovering from severe gastro-enteritis who require high protein diets to make up the tissues

lost during the illness. Several protein milks are available, e.g., Mead's Protein Milk and Prolac (Cow & Gate). High protein feeds are to-day more commonly made up by the addition of preparations consisting largely of calcium caseinate, e.g., Casec (Mead, Johnson & Co.), Caseinol (Glaxo), Prosol (Trufood). Such feeds are useful in treating infants suffering from Gastro-enteritis, Coeliac Disease, and Fibrocystic Disease of the pancreas.

Whey

Whey is made by precipitating the casein in milk. A simple method is by adding two teaspoonsful of rennet to 1½ pints of luke-warm milk, and allowing this to stand until cold. If the curd is now strained through muslin, the whey will exude. The composition of whey is as follows:

	per cent
Water	93.6
Protein	0.8
Fat	0.02
Sugar	4.65
Mineral matter	0.65

A most convenient way of obtaining whey is by using the whey powder Secway[1] (see Table VI, p. 63), which merely requires dilution with water. A glance at the composition will show that beyond a very small quantity of protein, the chief constituent of whey is sugar, and where a bland, non-irritating and slightly nutritious drink is required, whey may be given. It may be considered useful following on an attack of acute indigestion in an infant, and should be replaced by one of the skimmed dried milks or skimmed lactic acid milk.

Peptonized Milk

There are a number of preparations on the market for peptonizing (pre-digesting) the protein of cow's milk. Among those better known are Benger's peptonizing powders and liquor pancreaticus, but the principle of the various peptonizing substances is the same. The milk or milk and water is warmed to about blood heat and the active enzyme, either in powder or fluid form, is added.

[1] Made by Trufood Ltd.

The mixture is then allowed to stand for from twenty to thirty minutes, after which the whole is brought to a boil, the enzyme being in this way destroyed and further peptonization prevented. If the peptonizing process is continued for longer than twenty or thirty minutes, a slightly bitter taste is present.

Peptalac contains full-cream milk and dextrinized starch, which are subjected to the action of pancreatic enzymes for a given period of time. The mixture is then dried, preserving intact the vitamin content of the original milk and leaves a powder in which 22 per cent of the protein has been peptonized, and 25 per cent of the starch converted to a soluble and easily assimilated form. Composition (P.), 25.0 per cent; (F.), 14.0 per cent; (C.), 51.5 per cent; calorie value per ounce=125. Peptalac is made by Cow & Gate, Ltd.

CHOICE OF FOOD

When the necessity arises to take the infant off the breast, the practitioner is often asked to choose the best substitute for the natural food. Below are summarized the advantages and disadvantages of the various substitutes for breast milk.

1. Cow's Milk

One of the chief advantages is that cow's milk is less expensive than any other artificial food. A satisfactory food can be prepared by dilution with water and the addition of sugar (see p. 78.) It can be freed from pathogenic organisms by boiling or pasteurizing. Boiling modifies the protein curd and this makes it much more digestible (see p. 72). Some destruction of vitamins takes place, but the addition of orange or tomato juice and cod- or halibut-liver oil overcomes this drawback.

2. Full Cream Dried Milks.

(Ostermilk No. 2, Cow & Gate, National Dried Milk, etc.) (See p. 79.) The old prejudice against giving anything but fresh cow's milk has been modified by the success of dried milk. The advantages are that it is sterile, constant in quality, and, owing to the drying process which modifies the protein, more easily digested.

Dried milk is also easy to obtain, to keep and to make up. Possible disadvantages are the absence of vitamins, but it has been shown that the vitamins are not entirely destroyed, and their deficiency can easily be made up by giving fruit juice and cod- or halibut-liver oil each day. Vitamin 'D' is added by some makers to repair any deficiency. A disadvantage is that the cost of dried milk is greater than that of cow's milk (except National Dried Milk). Many physicians advise giving milks with a lower fat content than full-cream milks in the first few weeks of life (see p. 78.)

3. Unsweetened Full Cream Evaporated Milk.

(See page 80.) This is sterile, easily digested, and, as its sugar content is low, it can be readily modified as an artificial feed. Ten ounces of the unsweetened evaporated milk, together with 20 oz. of water and three level tablespoonfuls of sugar, make a suitable mixture. Stronger feeds can be given to the older infant (see Table XI).

4. Humanized Dried Milks.

(e.g., Humanized Trufood, Humanized Cow & Gate, Lactogen, etc.) (See p. 80.)

The authors do not consider that there is any superiority of humanized milks over full-cream dried milks. These feeds are reconstituted by adding one measure to 1 oz. of water.

TABLE VIII

FORMULA FOR INFANTS FED ON A COW'S MILK AND WATER MIXTURE

The requirements for 24 hours are given in the following table. It is best to prepare the milk for the whole day as it is difficult to make up the exact proportions of milk and water for individual feeds. The day's feeds should be kept in a refrigerator or a cool place.

Total for 24 Hours					
Expected Weight in lb.	Amount of Milk oz.	Amount of Water oz.	Level Teaspoons Sugar	No. of Feeds in 24 hours	Size of each feed oz.
6	12	6	6	6	3
7	14	7	7	5	4
8	17	8½	8	5	5
9	19	9½	9	5	5½
10	20	10	10	5	6
11	22	11	11	5	6½
12	25	12	12	5	7
13	27	11	13	5	7½
14	30	10	14	5	8
15	34	9	15	5	8½

Notes.—Two tablespoons of milk or water equal 1 oz. Four level teaspoons of sugar equal one level tablespoon. The milk should be boiled for three minutes.

TABLE IX

FORMULA FOR INFANTS FED ON DRIED MILKS WITH A LOW FAT CONTENT

(Half Cream Cow & Gate, Half Cream National Dried Milk, Half Cream Trufood, Ostermilk No. 1)

Individual Feeds				Total for 24 Hours			
Expected weight lb.	Dried Milk measures	Amount of water oz.	No. of feeds in 24 hours	Dried milk measures	Amount of water oz.	No. of feeds in 24 hours	Size of each feed oz.
6	3	3	6	18	18	6	3
7	4	4	5	21	21	5	4
8	4½ to 5	4½ to 5	5	24	24	5	4½ to 5
9	5 to 5½	5 to 5½	5	27	27	5	5 to 5½
10	6	6	5	30	30	5	6
11	6½	6½	5	33	33	5	6½
12	7	7	5	36	36	5	7

Notes.—Two tablespoonfuls of milk or water equal 1 oz.

Sugar in the proportion of one level teaspoon for each pound of body weight daily should be added to Half-Cream National Dried Milk and Half-Cream Trufood only.

When the baby is approximately 10 lb. in weight, change to a full-cream milk. (See Table X.)

TABLE X

FORMULA FOR INFANTS FED ON FULL CREAM DRIED MILKS

(Full-Cream National Dried Milk, Full-Cream Cow & Gate, Ostermilk No. 2)

Requirements for individual feeds and the total for 24 hours are given below.

Individual Feeds					Total for 24 Hours				
Expected weight lb.	F.C. dried milk measures	Amt. of water oz.	Level teaspoons sugar	No. of feeds in 24 hours	F.C. dried milk measures	Amt. of water oz.	Level teaspoons sugar	No. of feeds in 24 hours	Size of each feed oz.
6	2	3	1	6	12	18	6	6	3
7	3	4	1	5	15	21	7	5	4
8	3½	5	1½	5	17½	25	8	5	5
9	4	5½	1½	5	20	28	9	5	5½
10	4½	6	2	5	22½	30	10	5	6
11	5	6½	2	5	25	33	11	5	6½
12	6	7	2½	5	30	35	12	5	7
13	6½	7½	2½	5	32½	38	13	5	7½
14	7	8	3	5	35	40	14	5	8
15	7½	8½	3	5	37½	43	15	5	8½

Notes.—Two tablespoons of water equal 1 oz.
Four level teaspoons of sugar equal one level tablespoon.
Many physicians advise the use of a milk with a low fat content until the baby has reached 10 lb. in weight (see Table IX).

TABLE XI

FORMULA FOR INFANTS FED ON EVAPORATED MILK

(Carnation, Ideal, Libby's, Pet)

The requirements for the 24 hours are given below. It is best to prepare the milk for the whole day as it is difficult to make up the exact proportions for individual feeds.

Total for 24 Hours					
Expected weight in lb.	Amount of milk oz.	Amount of water oz.	Level teaspoons sugar	No. of feeds in 24 hours	Size of feeds oz.
6	5½	13	6	6	3
7	6½	14	7	5	4
8	7½	16	8	5	4½
9	8½	17	9	5	5
10	10	20	10	5	6
11	11	22	11	5	6½
12	12	24	12	5	7
13	14	24	13	5	7½
14	15	26	14	5	8
15	18	25	15	5	8½

Notes.—Two tablespoons of milk or water equal 1 oz.
Four level teaspoons of sugar equal one level tablespoon.

TABLE XII

FORMULA FOR INFANTS FED ON HUMANIZED DRIED MILKS

(Humanized Trufood, Humanized Cow & Gate, Lactogen, etc.)

The requirements for the individual feeds and the total for 24 hours are given below.

Individual Feeds				Total for 24 Hours			
Expected weight lb.	Humanized dried milk measures	Amount of water oz.	No. of feeds in 24 hours	Humanized dried milk measures	Amount of water oz.	No. of feeds in 24 hours	Size of each feed in 24 hours oz.
6	3	3	6	18	18	6	3
7	4	4	5	21	21	5	4
8	$4\frac{1}{2}$ to 5	$4\frac{1}{2}$ to 5	5	24	24	5	$4\frac{1}{2}$ to 5
9	5 to $5\frac{1}{2}$	5 to $5\frac{1}{2}$	5	27	27	5	5 to $5\frac{1}{2}$
10	6	6	5	30	30	5	6
11	$6\frac{1}{2}$	$6\frac{1}{2}$	5	33	33	5	$6\frac{1}{2}$
12	7	7	5	36	36	5	7
13	$7\frac{1}{2}$	$7\frac{1}{2}$	5	38	38	5	$7\frac{1}{2}$
14	8	8	5	40	40	5	$8\frac{1}{2}$
15	$8\frac{1}{2}$	$8\frac{1}{2}$	5	43	43	5	$8\frac{1}{2}$

Notes.—Two tablespoons of water or milk equal 1 oz.

Some infants will not tolerate the large proportion of fat in these foods, and need to be fed for the first few weeks on a milk with a lower fat content, e.g., Half-Cream Trufood, Half-Cream Cow & Gate (see Table IX).

CHAPTER FIVE

PRACTICAL ASPECTS OF ARTIFICIAL FEEDING

In the last chapter the various methods of artificial feeding of infants were described. In the present chapter the practical aspects of infant feeding will be discussed.

Expected Weight

'How much weight should we expect a normal healthy infant to gain?'

It is recognized that, for the first four or five days after birth, there is a loss of weight of an ounce or more daily. At the end of the first ten days, the infant should have regained his birth weight. From that time onwards, it is reasonable to expect an average gain of 1 oz. each day for a further ninety days. Thereafter, the gain is 1 lb. per month, up to the age of one year. Throughout this book the tables given are based on the assumption that the baby has thrived normally, and has reached this normal (expected) weight. (See p. 77.)

If the infant has made appreciably less than the normal progress in weight, the quantities will have to be modified upwards. Thus a doctor faced with the problem of feeding an infant of 10 lb., who should be weighing 12 lb., must base his feeds on the weight of 12 lb. (expected weight) and not on that of 10 lb. (underweight). He will discover that no satisfactory gain in weight will be achieved until he has done so.

Overweight children may not take the feeds calculated on their actual weight, and may gain weight on much smaller feeds, but their feeds must not be restricted if the infant wants the whole feed. It must be emphasized that individual babies differ in their food requirements, and that the progress of the infant is the ultimate test as to whether the quantities that have been prescribed are adequate.

Choice of Bottle

The bottles most commonly used are:

1. The boat-shaped bottle

2. The upright bottle

which are manufactured by many firms, such as Allenburys and Glaxo. (See Fig. 7.)

1. *The Boat-Shaped Bottle.* At one end of the bottle is the teat or rubber nipple, and on the other end a rubber valve. The advantages claimed for this pattern are that it is readily washed through and cleaned. Air passes through the valve, and thus it is not necessary to remove the teat from the infant's mouth to prevent a vacuum forming above the milk level, which tends to stop the outflow of milk through the teat. The disadvantage is, however, that unless the valve is most scrupulously clean, the milk may seal the hole in the valve. This will result in the flow of milk diminishing, and repeated sucking by the infant under such conditions tends to flatten the teat in his mouth. The nurse can readily recognize when the valve is not working, by noting that, on removal of the teat from the baby's mouth, a stream of bubbles rushes up through the milk. She should at once remove the valve and replace it by an efficient one. In the practical feeding of infants it is best to remove the valve altogether once the feed has commenced. (Fig. 5.) It is rather difficult to transport or sterilize feeds in a boat-shaped bottle, because of the valve leaking, but the substitution of a cork for the valve overcomes this difficulty. Another disadvantage is that these bottles are not obtainable in Pyrex glass, which withstands the heat better than ordinary glass.

(2) *The Upright or Soxhlet Bottle.* This is the bottle most commonly used. The great advantage of this type is the ease with which the feed can be sterilized in the bottle, and re-heated by standing in a jug of warm water before the feed is given. Moreover, it can be obtained in Pyrex heat-resisting glass. It must be recognized, however, that greater skill is required in the use of an upright bottle, in that at very short intervals the teat must be removed from the baby's mouth in order to allow air to enter the bottle. If bubbles do not stream up through the milk, a vacuum will form above the surface of the milk, the teat will collapse, and the milk will cease to flow. This may be overcome by the use of a teat with an opening or nipple at the base, through which air can enter the bottle while the baby feeds (see Figs. 6 and 9e). A variant of the upright bottle is the one shown in Fig. 8. This bottle has a wide

neck, making cleaning much easier. Moreover, it has an arrangement whereby the teat can be inverted, and the top screwed on. This preserves the sterility of the teat, and makes it very easy to carry the bottle when journeys are made.This bottle is obtainable from Bell & Croyden. It is not made in Pyrex glass.

Choice of Rubber Nipple or Teat

Some of the teats in common use are shown in the illustration (Fig. 9). The short stumpy type is exemplified by the Ingram and Allenbury's teats. The authors prefer this type for the normal healthy infant. Maw's so-called Anti-colic teat is popular. The valvular teat with the nipple at the base has been mentioned, and has the great advantage pointed out above.

Whichever type of bottle or teat is used, scrupulous care must be taken in keeping them clean and sterile. (See Appendix II.)

Times of Feeding

Most full-term infants can be fed four hourly, although some need more frequent feeds in the first two weeks of life. No strict rules can be laid down. Some feeble infants may need six or even seven feeds a day, because they are unable to suck full amounts at each feed.

The most convenient times of feeding will usually be found to be as follows:

Three Hourly: 6 a.m., 9 a.m., 12 noon, 3 p.m., 6 p.m. and 10 p.m.

Four Hourly: 6 a.m., 10 a.m., 2 p.m., 6 p.m. and 10 p.m.

As in breast feeding (see p. 30) absolute rigidity in times of feeding should be avoided. If an infant wakes up obviously hungry half an hour before the feed is due, it is better to feed the baby rather than let him scream. Similarly, if the baby wakes at 5 a.m., he should be fed. The last feed can be given as late as 11 p.m., if the baby is not hungry or is asleep. One can leave a baby asleep for say half an hour over the feed time, but he should be wakened then, otherwise the feeding times become very erratic. Most babies soon establish a rhythm in feeding and will wake up a little before or after a feed is due. Self-demand feeding is advocated by some, that is to say, giving a feed whenever the baby appears hungry. In practice, if the infant has adequate feeds the demand for food

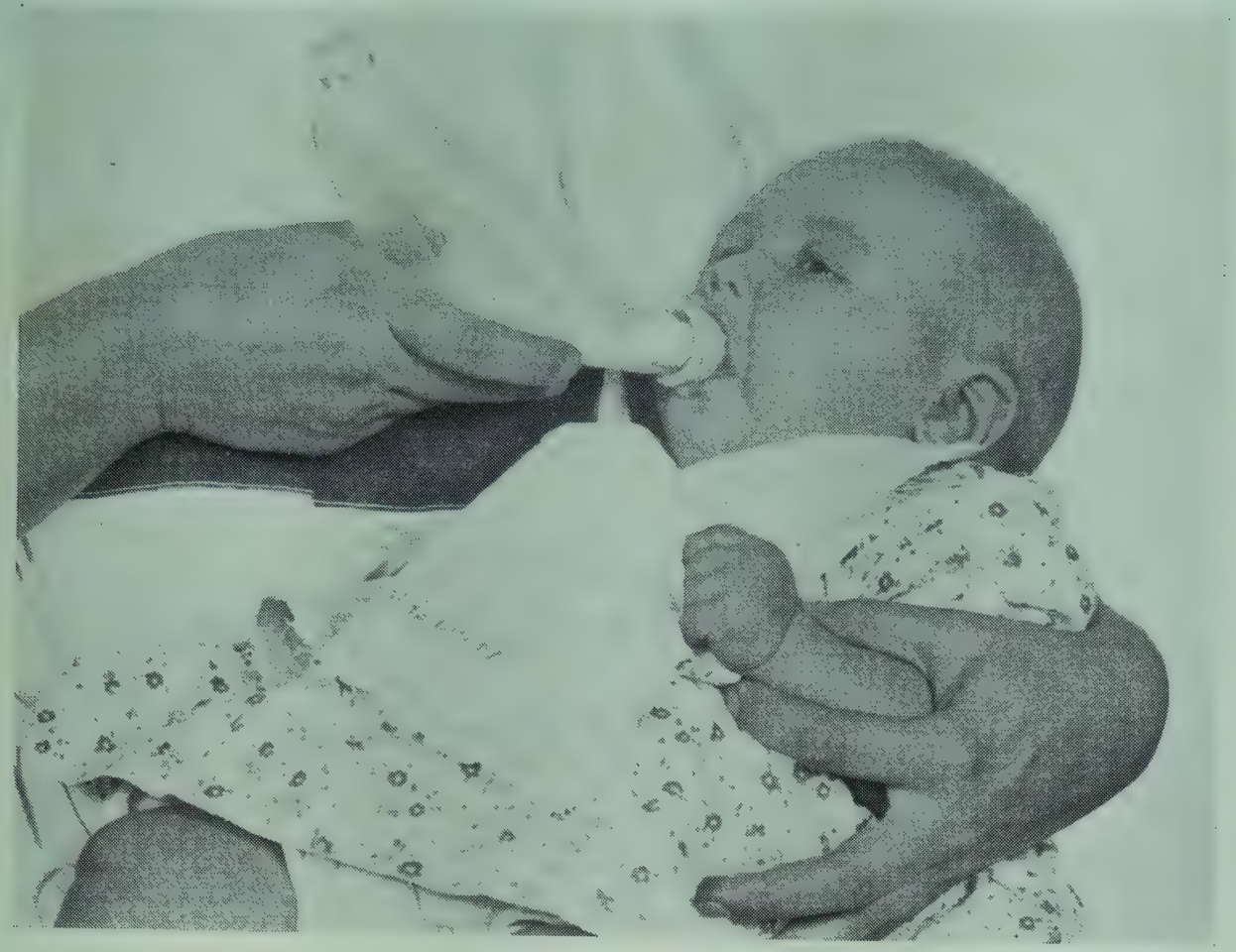


Fig. 5
Feeding an infant with a boat-shaped bottle. Note that the valve has been taken off.

Fig. 6
Feeding the baby with an upright bottle

Fig. 7
Soxhlet (upright) bottle and boat-shaped bottle.

(*a*) (*b*) (*c*)

Fig. 8
The Modern Nurser Bottle. (*a*) Ready for use. (*b*) Showing method of inverting the teat. (*c*) Showing teat inverted for carrying.

should occur at four-hourly intervals more or less. Some babies will not take sufficient milk at each feed, and may need feeding more frequently.

Night Bottles

Most babies very quickly learn to go through the night without being fed, though they may wake up an hour or so before the 6 a.m. feed. This interval enables the infant's digestion to obtain a complete rest.

Underfeeding in the day-time, excessive swallowing of wind which induces colic, are common causes of infants awakening at night and screaming. There is no doubt, however, that some very hungry babies will not go through the night, at any rate for the first few weeks, without being given a feed. If persistent night crying occurs due to hunger, it is better to give a feed rather than water, which rarely will satisfy the infant. Such night feeding, contrary to previous belief, does not become a habit and within a few weeks the baby will be able to sleep through the night.

The 'Sterofeed' electric bottle heater (see Fig. 12) is a very satisfactory method of warming-up the night feed. The heater is obtainable from John Bell and Croyden.

TECHNIQUE OF INFANT FEEDING

Time Taken Over the Feed

One of the most important points is the rate of the flow of the milk from the teat, which is, of course, dependent on the size of the hole in the teat. The authors would remind the reader that the human nipple has sixteen to twenty openings of considerable size, so that when once the milk has come in it flows or even spurts, when the baby suckles. The old idea that the infant 'should be made to work for its feeds' is not, therefore, justified.

By repeated weighings of the baby during a breast feed, it has been conclusively shown that the infant obtains most of its feed in the first five minutes, and very little milk after seven to ten minutes. It must be remembered that air or wind is sucked down during the act of swallowing the feed. An infant taking its feed in, say, a thousand sucks, must get less wind than one taking two

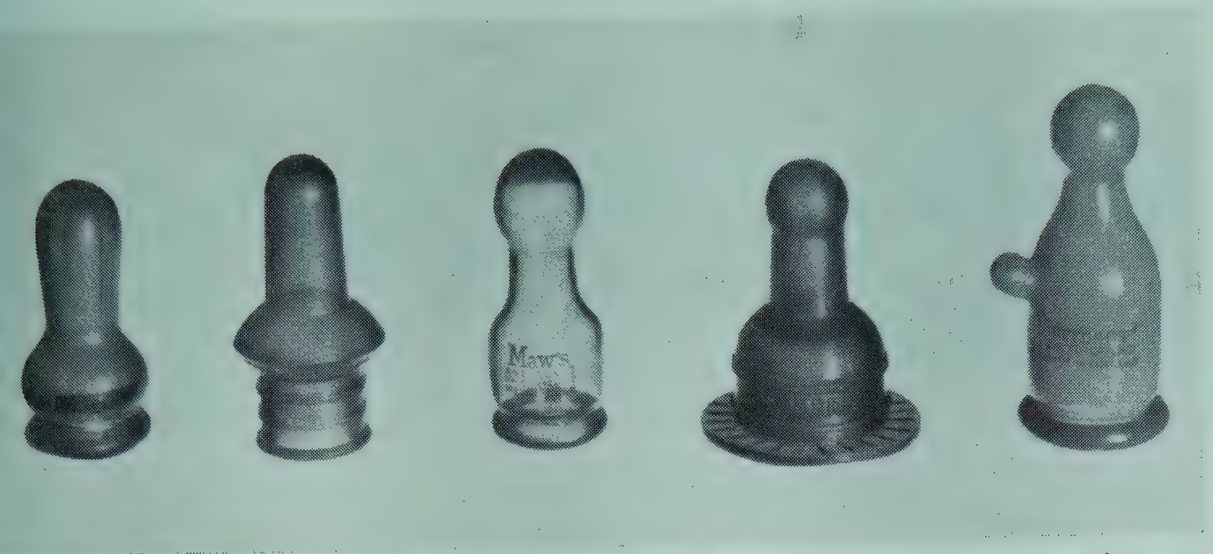
thousand sucks. Put shortly, the quicker the infant gets its feed, without gulping, spluttering or choking, the less wind he will swallow. *We believe the infant should take his feed quietly and easily in fifteen to twenty minutes at the most*, and our opinion is supported by our experience and that of other authorities.

The Size of the Hole in the Teat

Obviously the ability of the infant to suck well or poorly must be the deciding factor as to the size of the hole in the teat. A very good working rule, however, is to have a hole which allows the milk to drip out unaided at the rate of some sixteen drops to the minute. It is seldom, if ever, that a new teat is purchased with the hole absolutely suitable. This means that each individual teat should be tested and the hole adjusted. This is most conveniently done by means of a moderate-sized darning needle, the eye of which has been pressed into an ordinary cork. The bottle containing the food is held teat upward, and the needle, which has been made 'red-hot' by holding in a gas flame for half a minute, is plunged through the tip of the teat and immediately withdrawn. This should be repeated until the required flow (about sixteen drops to the minute) is obtained. The practice of making holes with the points of scissors is to be condemned.

Getting Up Wind

Since every baby swallows air normally with its food, this procedure is absolutely necessary, whether a baby be breast or bottle fed, and whatever is given from the bottle, even water or orange juice. Consideration of the anatomy of the stomach shows the necessity for the infant to be held in an upright position, allowing the swallowed air to be emitted through the gullet; the more placid and drowsy the infant, the quicker and more completely this is brought about. A shawl or blanket should be wrapped tightly round the infant to act as a splint to the weak back and 'wobbly' head. The infant should then sit upright on the nurse's knee (see Fig. 13). The nurse should not be afraid to tilt the infant well forward, so that he appears to look at the floor, and the infant's back should be gently patted or rubbed to help dislodge the bubbles of air from the stomach. Some infants bring up their



(*a*) (*b*) (*c*) (*d*) (*e*)

Fig. 9
A variety of teats in common use. (*a*) Allenbury. (*b*) Ingram. (*c*) Maw's Anti-Colic. (*d*) Modern. (*e*) Feedrite.

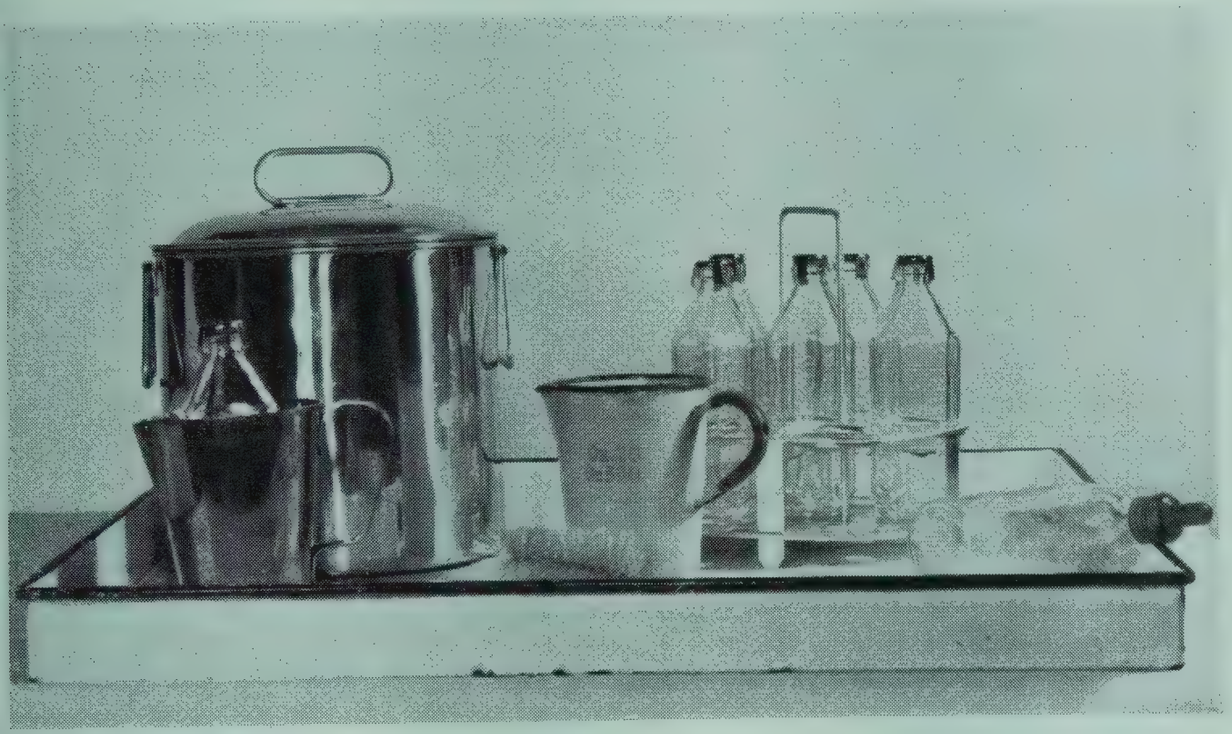


Fig. 10
The Soxhlet Apparatus

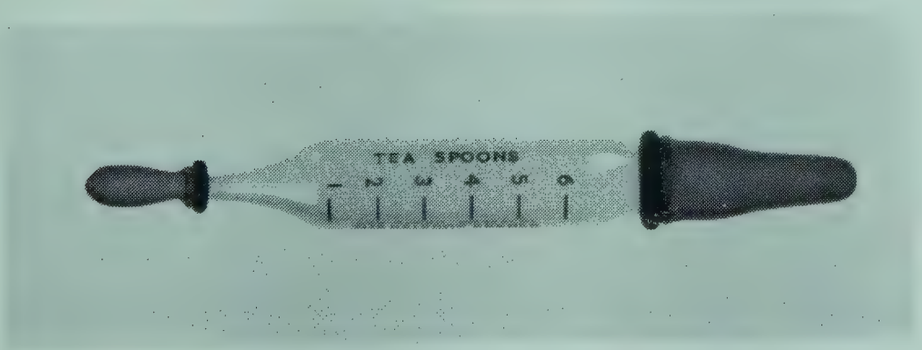


Fig. 11
The Bell-Croy Premature Baby Feeder. (*see p. 140*)

[*To face p. 94*

Fig. 12
Night feed heater (*Sterofeed*)

To face p. 95

wind best when placed well over the nurse's left shoulder. Getting up the wind may take up to twenty minutes, and the nurse should never be satisfied until three or four separate rifts (windy pops) have occurred. Wind not brought up will pass through the stomach with the food, accumulate in the bowel, and cause bursts of colic and screaming (Fig. 14). Every infant must be removed from the cot and held in the nurse's arms if the feed is to be administered properly. The practice of propping the bottle on the pillow and allowing the infant to feed lying flat in its cot cannot be too strongly condemned.

Preparing the Feed

When the feed of choice is a *dried milk*, individual feeds or the total requirements for twenty-four hours, may be made up as desired. The dried milk is carefully measured by the scoop supplied in the tin. This scoop is merely a measure and should not be used to remove the milk from the tin. This should be done by a boiled tablespoon from which the scoop is filled. After filling the scoop is levelled off. Teaspoons differ enormously in capacity, and are best avoided as measures when possible. The dried milk is mixed to a very smooth paste with a small quantity of cold water, in a small measuring jug marked in ounces, the required amount of hot water is added, and the whole stirred continuously until it is completely dissolved. The importance of this lies in the prevention of small clots, which tend to plug the hole in the teat. In pouring the milk from the jug to the bottle it may be an advantage to strain it. This procedure, however, should not be necessary if the feeds are properly prepared. The food must be given *warm*, but there is a tendency to overheat it. A thermometer should, therefore, be used at first to see that the temperature of the food approximates to 100° F., i.e., slightly above blood-heat.

Preparing Fresh Cow's Milk Feeds

Each feed may be made up separately, but, on the whole, the better method is to make up the feeds for the whole day. These can be kept in a large covered jug in a cool place. A Soxhlet apparatus is more convenient. (Fig. 10.) The requisite amounts of cow's milk, water and sugar are mixed together in a jug, and the five or six clean Soxhlet bottles are filled equally with the mixture.

These bottles are then firmly stoppered, and placed in the container, where they are heated until the milk in the bottles just begins to bubble. The bottles are then put in a refrigerator or cool place and used in turn, as each feed becomes due. A bottle is heated by standing in a jug of warm water. The teat is placed on it, and the mixture fed directly to the infant from this bottle. The authors advocate that the feed be transferred to a boat-shaped bottle if the baby is inclined to swallow a lot of air. (See p. 91.)

A simple form of Soxhlet apparatus can be improvised by taking five or six upright feeding bottles properly sterilized, and pouring an equal amount of the milk mixtures into each—closing each one with a plug of cotton wool. The bottles are then placed in a saucepan of water and heated until the milk just begins to bubble, and then put in a cool place. Each bottle is warmed up when wanted.

When the feeds are made separately it is best to sterilize the milk by bringing it to the boil when it is first received. Each individual feed should also be brought to the boil immediately before it is given. Where facilities for the keeping of the milk are not good, it is safer to use one of the dried milks.

Amount of Feed and Formulæ

Where it is imperative that the infant be artificially fed from birth, sips of warm water should be given at four-hourly intervals after the infant is twelve hours old. During the second day, one to two feeds of sugar water (one teaspoonful of sugar to 4 oz. of water) should be offered at regular intervals. A bottle should be used, as in this way the infant is taught to suck.

From the second to the fourth day, full amounts of feed are offered, but they are made up one-half of the strength given in the formulæ. Commencing on the seventh day, full strength feeds are given.

It is most important that the infant is always fed according to his '*expected weight*' and not according to his actual weight. The expected weight is calculated as described on p. 77.

Vitamin Supplements

All infants having artificial feeds should receive vitamin supplements starting at two weeks of age. Orange or tomato juice or

Fig. 13
Bringing up the wind.

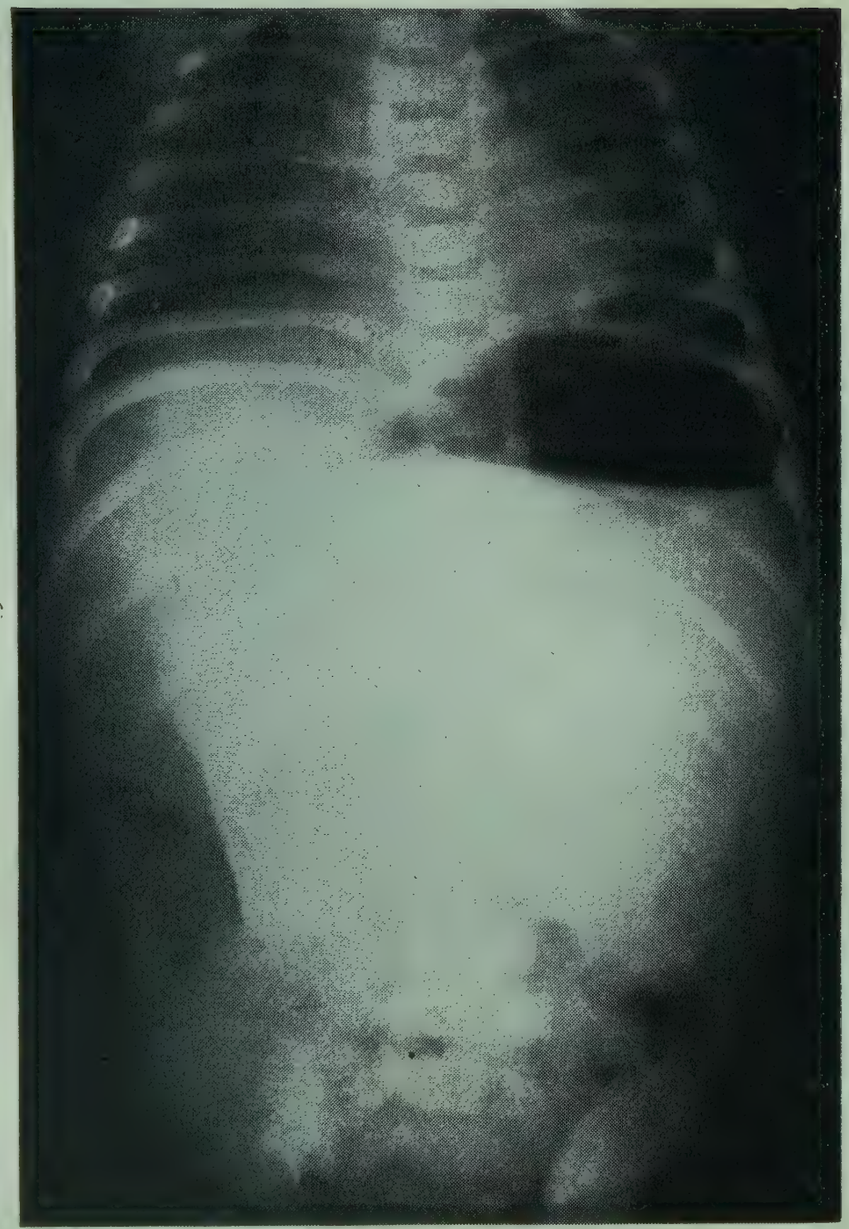
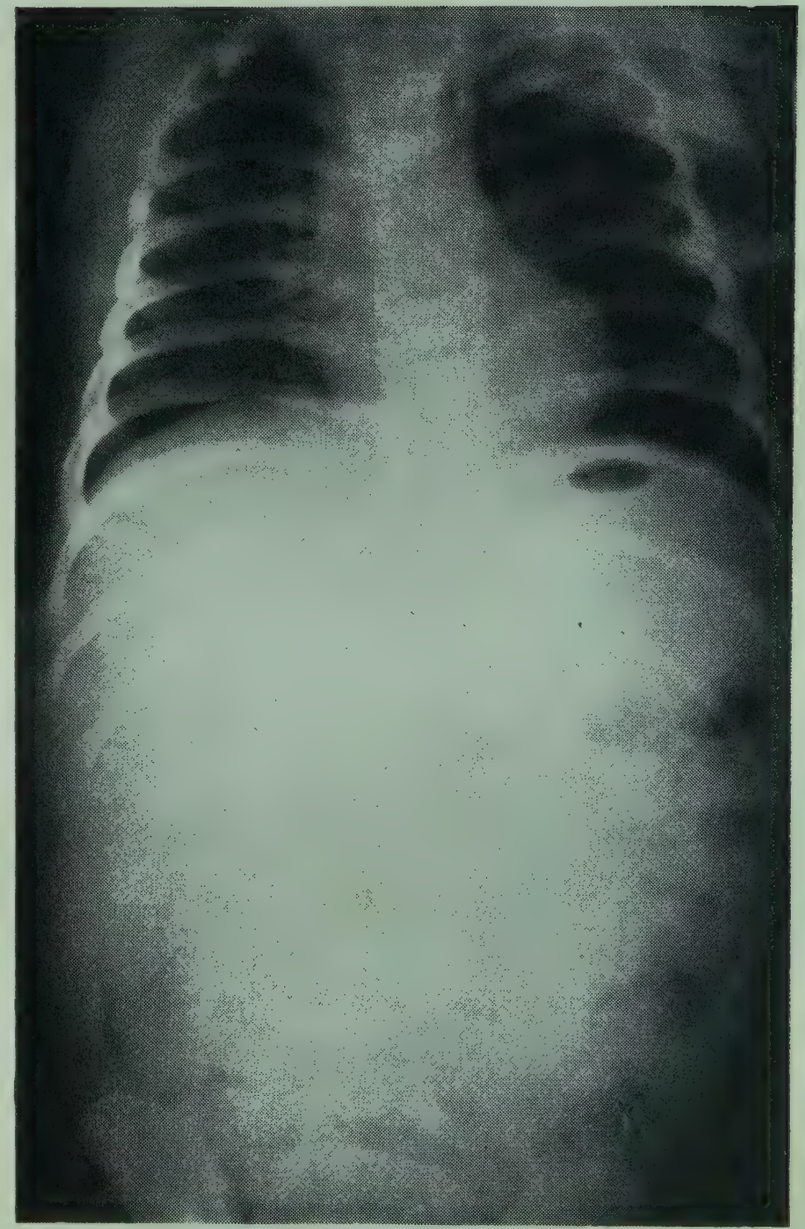


Fig. 14(*a*)
X-ray showing air in the stomach after



14(*b*)
X-ray of the same child after having

concentrated fruit-juice (orange or blackcurrant) or rose-hip syrup, two or three teaspoonfuls daily diluted with water and sweetened with sugar should be given. Should none of these be available, one 50 mg. tablet of ascorbic acid will provide the child with Vitamin 'C'.

One drop of halibut-liver oil should be given four times daily, placed on the outside of the teat before four feeds in the day or one teaspoonful of cod-liver oil given by spoon during the day, also before feeds. Alternatively, concentrated Vitamin 'D' preparations may be used.

Measures

Since directions are given in teaspoons, and since there is no universally accepted standard teaspoon and tablespoon, this causes confusion. It is always best to measure fluids in ounces, as very often an ordinary household tablespoon contains from ½ to 1 fluid ounce. Glass measures or measuring jugs marked in ounces on the inside, or even a child's feeding bottle marked in ounces, will be found much more accurate. In measuring solids, teaspoons vary enormously. Actually a level measure, as given in the tin (slightly pressed down), of skimmed, half-cream or full-cream dried milk weighs 1 drachm or ⅛ oz. A very heaped teaspoon of skimmed, half-cream or full-cream dried milk also weighs 1 drachm (if measured in a teaspoon purchased from Woolworths). A level teaspoon, slightly pressed down, is ½ drachm. A level tablespoon (Woolworth's size), slightly pressed down, of any of the above, is equal to 2 drachms (¼ oz.).

Sugar

This will be found to be much heavier than dried milk. One level teaspoonful equals 1 drachm. One level tablespoonful equals 4 drachms. A lump of Tate and Lyle's sugar weighs on the average 1 drachm. The tin measure given in Cow & Gate dried milk, if filled with brown sugar levelled off and slightly pressed, weighs 2 drachms.

It should be noted that an English pint is 20 oz., and an American pint 16 oz. An English tablespoon is exactly twice the size of an American tablespoon.

CHAPTER SIX

MIXED FEEDING FOR INFANTS AND DIETS FOR THE OLDER CHILD

Commencement of Mixed Feeding

THE TENDENCY in recent years has been to start mixed feeding at a much earlier age. As a general rule, one can introduce starchy foods at about three months of age, or when the baby is 12 lb. in weight. Vegetables and fruit can be added soon after. All these foods contain iron and thiamine, both of which are deficient in both human and cow's milk. Moreover, as the baby grows, it is difficult to satisfy his appetite with milk alone, though this will still remain for some months the main part of the diet.

Solid foods should be added gradually to the diet, starting with small amounts and increasing when it is seen that the infant tolerates them. Broth and vegetables are added at approximately three months of age and cereals soon after, first to one of the feeds, e.g., 10 a.m. and then to the 6 p.m. feed. Egg yolk and processed meat foods such as Din-Din[1] or Trufood meat spoon-food may be given between the fourth and fifth month. Thereafter, additional foods should be given at the beginning of the meal, followed by a milk drink. (See Charts.) Between six and seven months it is usually possible to wean the baby from the 10 p.m. bottle, giving only four feeds daily. This will vary with each individual child. From six to nine months increased quantities of cereals, vegetables, fruits and eggs are given. At about seven months fish may be introduced and meat a little later. At eight to nine months it is usually possible to change to three meals a day; breakfast, dinner and tea. The 2 p.m. feed is moved back to 1 p.m., the 10 a.m. feed being given earlier until finally it becomes the 8 a.m. breakfast. The 6 a.m. feed is given at 5 p.m. and changed to a more substantial meal. A small drink of milk may be given if necessary at 6.30 p.m. (See Chart.)

Charts for feeding between nine months and one year and for older children are given on pp. 105–112.

[1] Din-Din is obtained from Antigen Ltd., Roscrea, Eire, but is now stocked by many stores.

Cereal Feeding

The chief value of cereals in the diet is that they contain both iron and thiamine which are deficient in both human and cow's milk. For this reason, whole-grain cereals should be given rather than refined cereals. Most of the specially pre-cooked cereals have been fortified with Vitamin 'B'.

Despite some evidence to the contrary, from a practical standpoint it has been found that infants digest and thrive well on well-cooked or split starch granules, if given in small amounts only, from the second or third month onward. It is usual in this country to start adding starch seriously to the diet when the child reaches the age of three to four months. It is well at this time to add some form of starch to one feed only in the day—say the 10 a.m. feed, then the 2 p.m. feed, and finally, the 6 p.m. feed. The form of starch for breakfast, or the 10 a.m. feed, should be wheat, oat or barley flour—one heaped teaspoonful making about half a teacupful of the cooked product. At 2 p.m. the starch is offered to the infant in the form found in bone and vegetable broth—namely, potato, carrot, parsnips, etc. At 6 p.m., one of the cereals mentioned at 10 a.m. should be given, but not the same cereal.

Starch must be added gradually to the diet. If too much is given the child tends to become soft, flabby and pale and lacks energy. Only one feed of any one form of starch should be given in the day, for the greater the variety of starches fed, the more success is likely to be achieved. There is no objection whatever to the use of one of the well-known proprietary foods (see pp. 65-68), provided it contains an adequate amount of the Vitamin 'B' complex.

Cereals form an important part of the diet of the older child. They contain nearly 80 per cent of carbohydrate, but also a considerable amount of protein. The table below shows the composition of some of the more common cereals.

	Per Cent Carbohydrate	Per Cent Protein	Per Cent Fat
Oatmeal	72.8	12.1	8.7
Rice	86.8	6.2	1.0
Wholemeal flour ..	73.4	8.9	2.2
White flour	81.9	7.9	1.0
Barley	83.6	7.7	1.7
Rye	75.9	8.0	2.0

Oatmeal is much more rickets-producing than wheat flour because of its high phytic acid content, which precipitates calcium in an insoluble form, and thus makes it unavailable. This happens to a lesser extent in the 'National Flour'. To correct this fault it has been necessary to add calcium carbonate to the flour. Additions of cod-liver or halibut-liver oil with a full allowance of milk, will ensure against any rachitic tendency.

Some of the cereals in common use are oatmeal, porridge, Cream of Wheat, Groats and dried cereals such as Shredded Wheat or Grape Nuts, bread and toast, rusks, Ryvita Crispbread, ground rice, tapioca, sago, macaroni, spaghetti and vermicelli. The value of cereals depends not only on their carbohydrate content, but also on their vitamin, salt and protein content. One of our chief sources of Vitamin 'B' is to be found in cereal foods. Polished rice is, however, lacking in this respect.

The starch grains of different cereals vary in their digestibility, some requiring much more cooking than others to split them open, so as to liberate the starch. Some contain more cellulose, and have more residue on account of this. The great majority absorb a quantity of water during cooking, and swell to three or more times their original size. For example, a heaped teaspoonful of groats makes half a teacupful of cereal.

Wholewheat flour produces bread containing more Vitamin 'B' than white flour, but, on the other hand, because of its cellulose content, much less of the wholewheat bread is absorbed than bread made from white flour. This fact is taken advantage of where a residue is required in the intestine to combat constipation.

Vegetables

Vegetables are a valuable addition to the diet in that they contain iron and thiamine which are deficient in human and cow's milk. They are also a good source of Vitamin 'C', e.g., lettuce, tomato, cabbage and turnip. The pulses, e.g., potatoes, carrots and parsnips contain a high proportion of carbohydrate. Vegetables also contain calcium, magnesium and sodium.

Vegetables are added to the diet at three to four months of age, but may be given as early as two months. They are given in a bone

and vegetable broth, the vegetables being added towards the end of the cooking of the broth.

In cooking vegetables, steaming is much to be preferred to boiling, as a large proportion of the Vitamin 'C' and salts are wasted in the process of boiling. By steaming with a small quantity of fluid, this waste is almost completely eliminated. Vegetables should be cooked only for a sufficient length of time to make them soft. After being cooked the vegetables are passed through a fine sieve, thereby getting rid of the coarser, and consequently less easily digested parts of these foods. Spinach, cabbage, kale, sprouts, carrots, peas, celery, beans and cauliflower are the vegetables usually given to infants, either singly or in combination, usually being added towards the end of the cooking of the broth. Many of these can be obtained ready-prepared, sieved and also homogenized in tins in a number of brands, e.g., Brand's, Nestlé's, Libby's and Heinz. These tinned vegetables are very well digested and can be given at an earlier age than the coarser foods.

Vegetables should be added to the diet gradually, a teaspoonful being given at first. By stages the amount may be increased to two tablespoonsful daily. As the infant becomes older he should be given small amounts of some coarser, chopped vegetables. Gradually the proportion of sieved foods is diminished, until by the age of eighteen months the infant is taking only unsieved vegetables. If sieved foods are kept on too long, the baby may show great reluctance to take the coarser vegetables. Vegetables, especially spinach, sprouts or carrots, can often be recognized in the stools, but should not be discontinued because of this. A few infants, however, are over-sensitive to unsieved foods, and get loose stools. They may have to be kept on sieved vegetables up to two years of age.

Fruit and Fruit Juices

There are several reasons why raw fruit or fruit juice is valuable in feeding all infants and children. Besides the high Vitamin 'C' content (see p. 172), they are a means of providing carbohydrate in a pleasant form. Most fruits contain some iron, and thiamine. They also supply certain salts and water. In some fruits there is

also a large amount of cellulose, and by virtue of this, they tend to combat constipation.

Orange juice, tangerine juice or grapefruit juice, rose-hip syrup or blackcurrant purée, two or three teaspoonsful diluted with water and sweetened with sugar, should be commenced at once with all artificially- or breast-fed infants, irrespective of the fact that scurvy does not develop in children under six months of age. The kind of fruit juice given must be adjusted to the babies themselves. Orange juice suits most infants, but occasionally it appears to be badly tolerated, and in these cases one of the alternatives suggested above must be substituted. In a constipated infant between the age of six and nine months, a little strained prune juice or stewed fig juice is useful. Baked apple or apple sauce can be given from six months onward. Prune pulp is also quite well tolerated.

Warning. Some mothers or nurses discontinue the use of fruit juice when artificially feeding the child, because of a tendency to looseness in the bowels. It must be remembered that fruit juice is given for its Vitamin 'C' content, and although it may be necessary to discontinue its use for a day or two, it must be recommenced or scurvy will result.

Fruits commonly used are apples, apricots, peaches and prunes. They can be given from three or four months of age, after they have been well baked or stewed and pulped through a sieve. Towards the end of the first year they may be given unsieved. Over-ripe bananas contain a high proportion of carbohydrate and may be given from six months onwards. Commercial preparations of tinned puréed fruit will be found most useful.

Eggs

Eggs are one of the most valuable foods for the older infant and child, but they are not equally well tolerated by all children. The yolk of the egg is rich in phosphorus and iron, and in the fat-soluble Vitamins 'A' and 'D'. It also contains thiamine. The chief constituents of the egg are the fat in the yolk and protein in the white; the calorie value is about 70.

Eggs should be cautiously introduced into the diet at breakfast, or occasionally at the midday feed from four to five months on-

wards. If there is any hesitation over taking the yolk of a soft boiled egg, minute quantities only should be added, and a month should be taken before a whole yolk of egg is given. Between the ages of six months and a year, the yolks of four eggs may be given during the week. The egg yolk may be added to the milk mixture, given directly by spoon, made into an egg custard, or hard-boiled and made into a soft paste with a small quantity of milk.

Towards the end of the first year, the baby may be given the entire egg, but the white should be introduced cautiously and in small amounts at first. If no allergic response occurs, the whole of the white may be given.

Meat

Beef and mutton are easily digested meats and, if properly prepared, may be given at an early age. In this country it has been the practice not to give meat until the infant is approaching one year of age. Some of the specially processed meats, such as Din-Din, Trufood meat spoonfoods, can certainly be given at the age of four or five months or even earlier, and may be incorporated in the broth-vegetable mixture. Minced liver, finely-minced chicken, sweetbreads, minced kidney, brain, finely-minced beef, scraped steak, can be introduced gradually from about seven to eight months onwards. The advantage of these foods is that they are rich in first-class protein, and are therefore valuable for growth. They can replace carbohydrate as a source of energy, thus making it possible to give less sugar and starch, which tend to make the infant unduly fat.

Fish

Certain kinds of fish, such as plaice, sole, hake and fresh herrings, are well digested, but cod is not very digestible.

Fish can be introduced into the diet from six or seven months onward. It can be incorporated in the broth and vegetable mixture.

Cheese

Cheese must be looked upon as highly nutritious. It contains as much animal protein as meat, but on the other hand it contains one hundred times as much calcium as meat. Cheese may be given

to quite small children, if finely grated, on salads, in sandwiches or on potato. In older children it may be given as a main dish in the form of cauliflower cheese, or macaroni cheese, in the place of meat or fish.

Bread

Bread is a valuable article of diet, and is usually given to infants from seven to eight months onwards as toast or thin bread and butter.

Brown bread is preferable to the 'National Loaf' or white bread, since it contains more of the Vitamin 'B' complex and calcium salts.

FEEDING OF YOUNG CHILDREN

For the proper understanding of the feeding of children three things are necessary:

1. To ascertain that the child is having the proper food at regular intervals, not too frequently and in the proper amount.

2. That the child's general management as to its sleeping, eating, exercise and fresh-air habits are such as to provoke a healthy appetite.

3. That the person who actually offers the child the food does so in a manner conducive to its being taken, i.e., without undue urging, coaxing, bribing or harassing of the child.

Stuffing a child with food, especially starches, should be avoided, as this produces overweight, flabby children. No food should be given between meals. Three substantial meals a day are sufficient. (See pp. 108-112.) It has to be remembered that at two and a half years, when the first dentition is complete, the child has as many teeth and is as well able to chew and masticate his food, as he is at the age of five or six, and therefore, the composition of the food at this period is the same, the amount only of each food being varied.

It is essential that the diet should contain fresh foods in order to supply the necessary vitamins. Oranges or tomatoes supply the anti-scorbutic, whilst cod-liver or halibut-liver oil supplies the anti-rachitic vitamins during the winter months.

As a rule, the tendency is to overfeed children between the ages

of one and five on starches, giving them too little animal fat and protein. Such starchy foods as porridge, toast, bread, potatoes and milk pudding are given in excess, and animal proteins, because of their cost and the fact that they need cooking and that they perish easily, and to some extent because of the fallacious idea that the growing child does not need meat, are given in far too small quantities. On pp. 109-111 are shown suitable diets for children of from one to two years, and from two to five years respectively.

How Much Milk Should the Child Have?

There is no doubt that milk should be a staple article of the diet of the growing child. Nevertheless, next to starches, there is nothing which tends to be overdone so much as cow's milk. The common fault is to give the child from 1½–2 pints of cow's milk in the day, and then be surprised that solid food is not taken. One pint of milk should be sufficient between the ages of one and seven years to provide the growing child's bones and teeth with the necessary supply of calcium.

Kon[1] calculated that in a five-year-old child, one pint of good summer milk supplies a quarter of the daily needs of energy, three-quarters of the calcium, half of the protein, (including almost all the animal protein), slightly more than three-quarters of the Riboflavin, and just under a third of the Thiamin and Vitamin 'A'.

These facts bear tribute to the remarkable nutritive properties of milk, but also show that it is not necessary to give to a child having an adequate diet, more than one pint daily.

Diet for a Healthy Infant from Three to Six Months Old (Weight 12 to 16 lb.)

The change to this diet should take about four weeks.

Feeding Times—6 a.m., 10 a.m., 2 p.m., 6 p.m., 10 p.m.

6 a.m.	Boiled Cow's milk	Full-Cream National Dried Milk or Full-Cream Cow & Gate
	Milk, 6 oz.	6 measures
	Water, 2 oz.	Water, 7 oz.
	Sugar two level teaspoons	Sugar two level teaspoons

Alternatively, the milk and water mixture for the whole day may be made up. (See Table VIII). These formulæ will need to be increased in amount and strength during the fourth, fifth and sixth months.

[1] Kon, S. K.: *Brit. Med. Bull.*, 1947, 5, 1108.

10 a.m. Formula as above to which has been added one, increasing to three, heaped teaspoons of any of the following: Farex, Robrex, Scott's Baby Cereal, Trufood Cereal Food, Sister Laura's Food, Robinson's Patent Groats, (none of these need cooking) or M.O.F., Chapman's Entire Wheat Food (these need to be cooked in a single saucepan for one to three minutes). Alternatively, the cereal may be added to part of the milk and water mixture and given by spoon, the rest of the mixture being given by bottle. Later the milk should be offered from a cup.

Between four and five months small quantities of lightly-boiled egg yolk may be given. Start with half a small teaspoonful and gradually increase the amount.

2 p.m. Home-made bone and vegetable broth, two to four tablespoons (see below) together with two to four teaspoons of hand-sieved vegetables, *or* tinned baby soup and two to four teaspoons of homogenized sieved vegetables. (Heinz, Libby's, Brand's, or Nestlé's.) At four to five months, one to two teaspoons of Din-Din puréed liver, *or* Trufood Spoonfood puréed meat may be added to the broth and vegetable mixture. Follow with 4–5 oz. of the 6 a.m. milk formula.

6 p.m. Formula as at 6 a.m. together with one to three teaspoons of a different cereal *or* the formula followed by apple purée, apricot pulp, or a small quantity of mashed ripe banana. (Heinz and Trufood puréed fruits are very satisfactory.)

10 p.m. Formula as at 6 a.m.

All milk should be brought to the boil. In making the cereal for the 10 a.m. and 6 p.m. feeds, this can be made up with part of the milk formula added to it and fed either directly from the bottle with a large hole in the teat, or preferably with a spoon from a cup, the remainder of the formula being given from the bottle or a cup afterwards.

Fruit Juice

The juice of an orange or tomato diluted with water and sweetened with sugar, or alternatively, concentrated orange juice, tinned tomato juice, blackcurrant purée or rose-hip syrup—two to three teaspoons daily should be given, diluted with water and sweetened with sugar. Should none of these preparations be available at any time—one 50 mgm. tablet of ascorbic acid daily will help to provide the infant with the Vitamin 'C'. A convenient time for this is between 8 and 10 a.m. or at tea time.

To Prevent Rickets

One of the following should be given: one teaspoon of a good quality cod-liver oil, *or* four drops of halibut-liver oil, or six drops of a concentrated vitamin preparation daily.

Bone and Vegetable Broth

Place 1 lb. of freshly-chopped bones in a pressure cooker. Cover with water and bring to boiling point, reduce heat and cook for thirty minutes at pressure. Allow the pressure to fall, cool and strain the broth, and store in a cool place.

Sieved vegetables can be added to this. Fresh vegetables can be easily puréed in the Moolie Baby Sieve.

Broth similar to the above can be purchased ready-made from .Bickipegs Ltd., Nursery Food Specialists, Department 12, Welwyn Garden City, Herts.

Some infants thrive best when they reach the age of five to six months on four feeds per day. Those who sleep soundly all night may do without their 10 p.m. feed but other infants may do without the 6 a.m. feed. In the latter group the hours of feeding will require adjusting, as follows:

7 a.m. (or on waking). Orange juice.
8 a.m. Cereal and egg, etc.
12.30–1 p.m. Broth and vegetables, etc.
5.30–6 p.m. Cereal supper, etc.
10 p.m. Plain bottle.

Diet for a Healthy Infant from Six to Nine Months Old (Weight 16 to 19 lb.)

6 a.m. Boiled Cow's milk, 7 oz. — *or* — National Full-Cream Dried Milk or Full-Cream Cow & Gate, 7½ measures
Water, 1 oz. — Water, 8½ oz.
Sugar, three level teaspoons — Sugar, three level teaspoons
Between six and seven months of age, the baby should be gradually changed to undiluted milk or to a full strength full-cream dried milk.

10 a.m. Formula as above to which has been added two, increasing to four, heaped teaspoons of any of the following:
Farex, Trufood Cereal Food, Scott's Baby Cereal, Robrex, Sister Laura's Food, Robinson's Patent Groats (none of these need cooking) or M.O.F., Chapman's Entire Wheat Food. (These require cooking for one to three minutes in a single saucepan.)
Alternatively, part of the milk may be used to make the cereal and given by spoon, the rest being given as a drink from a cup. Half the yolk of a lightly-boiled egg three or four times a week, gradually increasing the amount until the whole yolk is given. A piece of crisp toast or a rusk may be given to the baby to chew.

2 p.m. Two to four tablespoons of home-made bone and vegetable broth (see below), together with one to two tablespoons of hand-sieved vegetables, *or* tinned soup together with two tablespoons of homogenized vegetables (Heinz, Libby's, Brand's, Nestlé's). Baked potato one to two tablespoons may be added. One to two teaspoons of steamed pounded fish may be given two or three times a week from the seventh month onwards. From seven to eight months, minced liver, minced kidney, finely-minced chicken or scraped underdone steak can be introduced into the diet. Start with a teaspoonful. All the above amounts should be gradually increased.
Milk: 4–5 oz. of the above formula (as at 6 a.m.).

6 p.m. Formula as at 6 a.m. together with two to four heaped teaspoons of a different cereal followed by apple purée, apricot pulp, or a small quantity of mashed ripe banana. Trufood fruit purées and similar preparations (Heinz) will be found useful.

10 p.m. Formula exactly as at 6 a.m.

Fruit Juice

The juice of an orange or tomato diluted with water and sweetened with sugar, or alternatively, concentrated orange juice, tinned tomato juice, blackcurrant purée or rose-hip syrup—two to three teaspoons daily should be given, diluted with water and sweetened with sugar. Should none of these preparations be available at any time—one 50 mgm. tablet of ascorbic acid daily will help to provide the infant with its Vitamin 'C'. A convenient time for this is between 8 and 10 a.m. or at tea time.

To Prevent Rickets

One of the following should be given—one teaspoon of a good quality cod-liver oil, four drops of halibut-liver oil, or six drops of a concentrated vitamin preparation daily.

Bone and Vegetable Broth Recipe

Place 1 lb. of fresh chopped bones in a pressure cooker. Cover with water and bring to boiling point, reduce heat and cook for thirty minutes at pressure. Allow the pressure to fall, cool and strain the broth and store in a cool place. Sieved vegetables can be added to this. Fresh vegetables can be easily puréed in the Moolie Baby Sieve.

Broth, similar to the above, can be purchased ready-made from Bickipegs Ltd., Nursery Food Specialists, Department 12, Welwyn Garden City, Herts.

Most infants between six and nine months require only four feeds a day, relinquishing either the 10 p.m. or 6 a.m. bottle. In the latter group, the hours of feeding need to be adjusted as follows:

7 a.m. (on waking). Orange juice.
8 a.m. Cereal and egg, etc.
12.30–1 p.m. Broth and vegetables, etc.
5.30–6 p.m. Cereal supper, etc.
10 p.m. Plain bottle.

Between eight and nine months one should change to a three meal a day schedule.

Diet for a Healthy Infant from Nine Months to One Year Old

Note.—The transition from the previous diet to this one should be slow, taking about two to three weeks.

On Waking

The juice of an orange or tomato diluted with water and sweetened with one teaspoon of sugar. One small rusk or biscuit may be offered. Alternatively, one of the following: bottle orange juice—one teaspoon, blackcurrant purée—two to three teaspoons, rose-hip syrup—one to two teaspoons.

In order not to spoil the child's appetite for breakfast, it is best not to give milk at this time. If the baby sleeps through until breakfast, the fruit juice and biscuit can be given in mid-morning.

Breakfast, 8 a.m.

1. Half a cup of cereal such as Farex, Robrex, Scott's Baby Cereal, Trufood Cereal Food, Groats, M.O.F., Chapman's Entire Wheat Food, Cream of Wheat, etc., or rusks (see directions below for making these at home), and milk, or Robb's biscuit and milk fed from a cup.
2. Four mornings a week give the whole of a lightly-cooked egg by spoon, and on one or two mornings, crisp toast fried in bacon fat, or chicken or beef dripping. On one or two mornings instead of the above, one to two tablespoons of steamed fish may be given.
3. 8 oz. of milk (including that given with the cereal). Vary the first course as much as possible.

Dinner, 12.30 p.m.

1. One to two tablespoons of mashed potato (potatoes should be cooked in their skins to retain the Vitamin 'C'), and one to two tablespoons of finely-sieved vegetables (carrot, spinach, swedes, brussels sprouts, etc.) moistened by four tablespoons of home-made broth. Alternatively, tinned baby soup and homogenized vegetables (Heinz, Libby's, Nestlé's or Brand's) may be given.
   One to two tablespoons of one of the following: finely-minced beef, underdone scraped steak, minced chicken, rabbit, minced liver, kidney, sweetbreads, or white fish should be added to the broth-vegetable mixture.
2. One to two heaped tablespoons of egg custard, junket, ground rice, tapioca, sago, semolina with jelly, apple purée, or homogenized fruits (Brands, Trufood).
3. Four ounces of milk at this meal which should be used for making up the pudding.
4. Water to drink.

Tea, 4.30–5 p.m.

1. A cereal as at breakfast or rusks and milk, or Robb's biscuit and milk, or preferably rusks spread with butter, or thin brown bread and butter.
2. Junket or stewed fruit, or custard.
3. 8 oz. of milk including the amount used in the first course. As a rule, no food should be given after tea. If the baby is thirsty, a small drink may be given at 6–6.30 p.m. before the baby goes to sleep. An infant should normally have completely discontinued the 10 p.m. bottle by the ninth month and should be fully on cup and spoon feeding.

Milk

All milk should be brought to the boil.

To Prevent Rickets

One of the following should be given: one teaspoonful of a good quality cod-liver oil, or four drops of halibut-liver oil, or six drops of a concentrated vitamin preparation daily.

Home-Made Bone and Vegetable Broth Recipe

Place 1 lb. of fresh chopped bones in a pressure cooker. Cover with water and bring to boiling point. Reduce heat and cook for thirty minutes at pressure. Allow the pressure to fall, cool and strain the broth and store in a cool place.
Sieved vegetables can be added to this. Fresh vegetables can be easily puréed in the Moolie Baby Sieve.

Rusks Recipe

4 slices of stale bread, brown or white.
¼ pint of milk.
1 tablespoonful of sugar.

Method.—Remove the crust from the bread and cut into fingers one inch wide. Dissolve the sugar in the milk and dip in the fingers of bread. Place on a baking sheet and dry the rusks in a slow oven until they are a pale golden brown.

Diet for A Healthy Child from One to Two years

On Waking

Orange juice, tomato juice or grape-fruit juice, 2–3 oz. diluted with water and sweetened with sugar. Alternatively, bottled orange juice, or blackcurrant juice, or rose-hip syrup may be given. One small rusk or biscuit should be offered. In order not to spoil the child's appetite for breakfast, it is best not to give milk at this time. If the child sleeps through until breakfast, the fruit juice and biscuit may be given in mid-morning.

Breakfast, 8 a.m.

1. A helping of cereal such as Farex, Robrex, Chapman's Entire Wheat Food, Trufood Cereal Food, Robinson's Patent Groats, M.O.F., Rusks, Robb's biscuit and milk, and toast. At about eighteen months some of the breakfast cereal foods may be introduced, e.g., Cornflakes, Cream of Wheat (see 2–5 year Diet Sheet). (In warm weather stewed fruit purée and crisp toast may be given in place of the above.) Vary this course as much as possible. It should not be large enough to satisfy the child's appetite.
2. Crisp toast fried in bacon fat or chicken or beef dripping, or a small rasher of crisp bacon, or a soft boiled egg three or four days a week. (The white of the egg may be given from one year onwards but should be gradually introduced as some children are allergic to egg albumin.)
3. Lightly-cooked pounded plaice, sole, or herring two or three days a week.
4. 8 oz. of milk (including that used with the cereal).

Dinner, 12.30 p.m.

1. A moderate helping of any of the following: finely-minced beef or underdone scraped steak, white fish (boiled or steamed), pounded chicken, Irish stew, rabbit, brains, or sweetbread, or scraped lightly-cooked liver.
2. One to two heaped tablespoons of boiled, baked or mashed potatoes (these are best cooked in their skins to retain the Vitamin 'C') and one to two heaped tablespoons of one of the following: sieved brussels sprouts, cabbage, spinach, greens, carrots, cauliflower, turnips, parsnips, etc., or Heinz, Libby's, Brand's, sieved vegetables.
   With most infants, it should be possible to discontinue sieving vegetables by the age of eighteen months at the latest.
3. Milk pudding (floured or ground rice, sago, semolina, fine tapioca, etc.) with puréed fruit such as prunes, apples, pears, apricots, or jelly, junket, or custard.

Tea-Supper, 4.30–5 p.m.

1. Cereal as at breakfast or thin bread and butter with a little honey, seedless jam, Marmite, etc., and custard, junket, or stewed puréed fruit, and a small piece of sponge cake.
2. Between one year and eighteen months, rusks, Robb's biscuit or crisp toast soaked in warm milk.
3. 8 oz. of milk including any used with biscuits.

6.15 p.m.

It ought not to be necessary to give anything after tea-supper. If the child eats a poor meal, some of the milk and rusks may be kept and offered before he is put to bed but this should not be done as a routine.

Milk

One to one-and-a-half pints a day should be sufficient including that used in cooking. All milk should be brought to the boil or efficiently pasteurized. After boiling, the milk should be quickly cooled and covered.

Sweets

Plain boiled sweets such as barley sugar and fruit drops may be offered after dinner or tea. It is best to clean the teeth immediately afterwards.

To Prevent Rickets

One of the following should be given: one teaspoonful of a good quality cod-liver oil, or four drops of halibut-liver oil, or six drops of a concentrated vitamin preparation daily.

N.B.—Some of the solid constituents should be introduced slowly during the period from one to two years, the whole diet not being suitable to commence with.

Diet for a Healthy Child from Two to Five Years

On Waking

Orange juice, tomato juice or grape-fruit juice 2–3 oz. diluted with water and sweetened with sugar. Alternatively, bottled orange juice, or blackcurrant purée, or rose-hip syrup may be given.

(*Note.*—These amounts are approximate and should be adjusted to suit the individual child.) Milk should never be given at this time but one small rusk may be offered.

Breakfast, 8 a.m.

1. A helping of porridge, cornflakes, Weetabix, Grape-nuts, Shredded Wheat, Cream of Wheat, Puffed Rice, or other cereal with milk. In place of one of these especially in hot weather, stewed apples, prunes, plums, cherries, figs (puréed for young children), may be given. (Do not satisfy the appetite with this course.)
2. A soft cooked scrambled or poached egg, *or* tomatoes and a rasher of crisply-fried bacon, *or* fish (sole, plaice, haddock, herring) *or* lightly-cooked liver or kidney.
3. Crisp toast or rusks, or whole-meal bread spread with butter.
4. A glass of milk.

Dinner, 12.30–1 p.m.

1. A helping of any of the following: lamb chop, underdone beef, steak (finely cut up), sweetbreads, liver, kidney, chicken or fish (boiled or steamed, not fried), brains, tripe, rabbit, or sheep's heart. (The meat should be minced for young children.)
2. A helping of boiled, mashed, or baked potatoes. (All potatoes are best cooked in their skins to preserve the Vitamin 'C'.)

3. A helping of one but preferably two of the following vegetables: mashed carrot, spinach, brussels sprouts, cabbage, spring greens, peas, beans, parsnips, swedes, turnips, cauliflower, etc. (These should be puréed for young children.)
   All raw vegetables should be either steamed or cooked in very little water which should afterwards be added to soups and gravies.
   After the age of four, raw salads composed of shredded lettuce, beetroot, carrot, chopped tomatoes, apples, and celery are desirable.
   A suitable dressing can be made from lemons, egg and cream.
4. Suggested desserts: milk puddings, such as rice, tapioca, sago, steamed pudding, custard, jelly, junkets, blancmange, ice cream, banana or stewed apples, apricots, pears, prunes, or peaches.
   Water to drink.

Tea-Supper, 5 p.m.

1. Crisply-toasted wholemeal or brown bread and butter, or rusks with butter, spread with honey, seedless jam, or cream cheese, or honey and jam sandwiches.
2. Stewed fruit or jelly.
3. A small piece of sponge cake.
4. A glass of milk.
   For the older child, a more substantial supper may be needed, and may include cream or vegetable soup, or an egg dish, or macaroni or spaghetti. This meal can be given a little later at 5.30–6 p.m. As a rule no food should be given after supper.

Milk

One to one-and-a-half pints of milk should be given daily, including that used for cooking. Some children prefer milk flavoured with cocoa or tea. All milk must be boiled or efficiently pasteurized. After boiling, the milk should be quickly cooled and covered.

Sweets

Plain boiled sweets such as barley sugar may be offered after dinner or tea. The teeth should be cleaned immediately afterwards.

Vitamins

Fresh fruit juices provide adequate Vitamin 'C'. In winter-time, one teaspoon of a good quality cod-liver oil or four drops of halibut-liver oil, or six drops of a concentrated vitamin preparation should be given daily.

Diet for Children of School Age

The growing child requires a substantial and mixed diet. It should contain fresh meat and fish, an abundance of fresh vegetables and fruit, butter, milk, eggs, and it should be properly balanced with sugar and starch. A child of twelve years requires as much food as either parent.
Many children attending day schools have a cooked lunch at school. Others come home to lunch. Sometimes children have to take a packed lunch. (See below.)

Breakfast

1. A ripe apple, orange or grapefruit, or tinned or stewed fruit, or tomato juice.
2. Porridge or one of the following cereals (preferably whole grain or enriched). Corn flakes, Shredded Wheat, Weetabix, Wheatena, Cream of Wheat, Puffed Rice, etc., with milk.
3. An egg, soft cooked, scrambled, poached, or fried, *or* crisply-fried bacon with tomato, *or* sausages *or* fish.
4. Toast or bread and butter with marmalade or jam.
5. A cup of milk or weak tea.

Dinner

1. Cutlet, fresh mince or stew, a cut of roast beef or mutton, steak, chicken, fish, sweetbreads, rabbit, liver, etc.
2. Boiled, baked or mashed potatoes (which are best cooked in their skins), with carrots, cauliflower, parsnips, swedes, leeks, boiled onions, or green vegetables such as brussels sprouts, spinach, cabbage, spring greens, or peas or beans. In addition green salads.
3. Stewed fruit, milk pudding, or custard, or sponge or steamed pudding, or fruit pie, or tart, or junket, yoghourt, or fresh fruit.
   Water to drink.

Tea-Supper

1. Thin bread and butter spread with honey, jam, cream cheese, or Marmite. Stewed fruit, such as baked apple or stewed figs, prunes, rhubarb, apples, greengages, etc., or milk pudding.
2. Cake or scone, milk or weak tea, or cocoa with milk.

As the child approaches the age of seven or eight, a more substantial tea-supper is required.

Suitable suppers are:

Soups followed by a savory; any of the following dishes are suitable: minced meat and vegetables, cold meat, corned beef, spam, ham, sardines served with salad, fish and potatoes, scrambled egg on toast, cheese on toast or cheese salad, roes on toast, grilled sausages and tomatoes, smoked haddock or fresh herrings. Baked beans on toast. Wholemeal bread and butter may be eaten with this meal.

Finish the meal with raw fruit if desired.

Milk

Each child requires one to one and a half pints of milk per day including that used in cooking,

School Lunch

If a child cannot get home for a cooked meal and school dinners are not available, a packed lunch may be taken, in which case a substantial meal similar to the dinner should be given on his return from school.

In winter a suitable lunch would be a Thermos of hot soup and some sandwiches containing beef or ham with lettuce, cheese or egg, followed by some cake and fruit such as an apple, orange, and banana, and, of course, milk.

In summer omit the soup. Give sandwiches, fruit in season and milk.

CHAPTER SEVEN

DIARRHŒA, VOMITING, COLIC AND CONSTIPATION

Among the commonest symptoms which the practitioner is called upon to deal with in infants are diarrhœa and vomiting. It is of the utmost importance that the doctor should have a clear knowledge of their commoner causes as they may either be manifestations of some serious illness or merely of some transient disturbance.

DIARRHŒA

Diarrhœa in breast-fed infants has been discussed on p. 50.

Diarrhœa in infancy is due to three main causes:

1. Acute dyspepsia due to excess of fat or sugar (dietetic diarrhœa).

2. An infection of the bowel by some pathogenic organism (infective diarrhœa). Epidemics of this type of diarrhœa were at one time very common in the summer months (summer diarrhœa).

3. Some infection outside the intestinal tract (symptomatic or parenteral diarrhœa) such as otitis media, pyelitis, naso-pharyngitis, etc.

1. Dietetic Diarrhœa

This is to-day relatively uncommon, owing to improved knowledge of infant feeding. Excess of sugar will give rise to acid loose stools due to excessive fermentation in the intestine. A diet too rich in fat if persisted in will also cause diarrhœa. Certain infants have an intolerance of fat, especially during the early weeks. Unlike infective diarrhœa, which has a sudden onset, dietetic diarrhœa commences slowly and insidiously. If recognized early and the diet corrected the symptoms will gradually clear up. If the diet is persisted in, the infant may develop symptoms of dehydration.

2. Infective Diarrhœa, or Gastric-enteritis

In this type there occurs an inflammation of the gastro-intestinal tract. Some of these cases are caused by organisms of the Salmonella group, e.g., S. typhimurium (*B. Aertryke*) and S. enteritidis (*B. Gaertner*), the so-called food poisoning bacilli.

In the majority of cases of infective diarrhœa, no specific organism can be isolated. In recent years, certain strains of E. Coli (*E-Coli Neopolitanum*) have been isolated from the stools in epidemics of diarrhœa (Bray[1]-Czigany[2]) and much recent work has been published to the same effect. It has not yet been generally accepted that strains of E. Coli are the cause of the gastro-enteritis.

During the past few years the possibility of a viral causation has been explored but little success has been obtained in the isolation of a virus. Light and Hodes[3], however, provide evidence that epidemic neonatal diarrhœa is due to a virus infection.

Infective gastro-enteritis may be mild with little vomiting and only moderate diarrhœa, the symptoms clearing up after a short period of starvation and a few days on dilute feeds. In the more severe cases, vomiting may be frequent and these infants may pass frequent watery stools. The onset is sudden. Dehydration generally occurs within forty-eight hours of the onset and is manifest by a depressed fontanelle, sunken eyes and an inelastic skin. Such infants require parenteral fluid therapy.

Another form of infective diarrhœa which is less common in infancy than in older children is caused by the Dysentery (Sonne) bacillus. The disease chiefly affects the large bowel though the terminal ileum may be affected. Multiple mucosal ulcers are present. Frequent stools containing blood and mucus are passed. After two to three days the diarrhœa lessens. The constitutional symptoms may be quite severe in infancy with high temperature and dehydration. Administration of one of the insoluble sulphonamides, e.g., sulphasuccidine, or chloramphenicol will cut short the infection.

3. Parenteral or Symptomatic Diarrhœa

Diarrhœa may be a symptom in such infections as otitis media,

[1] Bray, J.: *J. Path & Bact.*, 1945, **57**, 239.
[2] Czigany, F.: *Arch f Kinherbeilk*, 1941, 122, 147.
[3] Light, J. S. and Hodes, H. L.: *J. Exp. Med.* 1949, 90, 113.

pyelitis, tonsillitis and naso-pharyngitis and careful examination for a source of infection should be made in any infant who develops diarrhœa. Parenteral infection, especially otitis media, is of course common in infants suffering from gastro-enteritis. Severe diarrhœa leading to dehydration rarely results from parenteral infection. In addition to dietetic restrictions chemotherapy should be given to clear up the primary infection.

Treatment of Diarrhœa

It is not proposed to discuss in detail the treatment of severe diarrhœa, for which reference should be made to the standard textbooks. The most serious effects of diarrhœa are dehydration and loss of electrolytes, viz., chloride from the stomach and certain bases in the stools.

If the case is a slight one, there is usually little vomiting and fluids may be given by mouth. It is best to stop all food for twenty-four hours and either half-strength Hartmann's solution or a solution containing 2.5 per cent dextrose in half-strength normal saline is given by mouth at two-hourly intervals.

Thereafter dilute half-cream milk feeds are given, gradually increasing the strength over three or four days. Drinks of bland fluid, such as water, glucose-water or well-diluted and sweetened fruit juice or freshly-brewed weak tea may be offered between feeds if the infant is thirsty.

In more severe cases, when vomiting is not a feature, the following scheme may be followed.

For twenty-four hours, give hourly drinks of one or more of the following: half-strength normal saline, Hartmann's Solution (see appendix, p. 180), glucose water or freshly-brewed weak tea.

Commencing the second day give:

1 part of milk to 8 parts of Hartmann's or half normal saline	For 12 hours
2 parts of milk to 8 parts of Hartmann's or half normal saline	
4 parts of milk to 6 parts of Hartmann's or half normal saline	
5 parts of milk to 5 parts of Hartmann's or half normal saline	

and so on until the correct milk strength for the age is reached.

The fluid requirements may be considerable. It is estimated that 10 per cent of the body fluid may be lost in 24–48 hours in the lesser degrees of dehydration and as much as 25 per cent in severe dehydration. This loss of fluid must be made up, as well as the ordinary requirements of 3 oz. per lb. of body weight daily. If vomiting or dehydration are severe, parenteral administration of fluid and electrolytes will be necessary. In such cases hospitalization is essential. As a result of recent Medical Research Council Therapeutic trials, chloramphenicol and sulphadiazine were found to have a beneficial effect in gastro-enteritis.

DIARRHŒA IN OLDER CHILDREN

The effects of diarrhœa are much less serious in infants over one year of age since electrolyte disturbances are less common.

Diarrhœa in the early years of life may be due to sensitivity to certain foods. Some young children are especially liable to develop loose stools from eating raw fruit, vegetables and high-residue foods generally.

Infective diarrhœa is usually due to infections with the Salmonella and Shigella group of organisms. S. Dysenteriae (Sonne) infections are common and may spread rapidly in nurseries. The onset is sudden, with the passage of eight to ten stools in the day, some containing blood and mucus. Abdominal colic may occur but vomiting is uncommon. Constitutional symptoms are mild. The diarrhœa lasts for a week or ten days, gradually becoming less severe. For the first two to three days while the diarrhœa is severe, fluids such as sugar water, lemon or barley water should be given. Thereafter a bland low residue diet may be given.

Sonne dysentery infections may be cut short by administration of one of the insoluble sulphonamides, e.g., Sulphasuccidine or Sulphaguanadine. The dose is 2 grains per pound of body weight daily given at four or six hourly intervals day and night for three to five days. (Each ½ gramme tablet contains 7½ grains of the drug.)

Chloramphenicol (Chloromycetin Palmitate is a palatable form for children) is also very effective. It is given in a dose of 20 mg. per pound of body weight daily at six-hourly intervals day and night for four to five days.

Diarrhœa in the older infant or toddler may be treated by the apple diet. This depends on the presence of malic acid derivatives in the apple which have the effect of solidifying the stools. A simple method of preparation consists of finely grating a fresh ripe apple. From a teaspoonful to several tablespoonfuls should be given at each feed depending on the age of the child and fed from a bottle or spoon. Drinks of weak tea bringing the total fluid intake up to 3 oz. per pound of body weight daily are given between apple feeds. The whole treatment lasts three or four days.

Prevention of Diarrhœa

1. All feeding utensils, such as bottles, teats, brushes, etc., must be sterilized by boiling or by immersion in a hypochlorite solution after each feed, and kept covered in cold water.

2. Careful attention should be given to the sterilization of the feed itself, the cleanliness of the mother's or nurse's hands and prevention of contamination of the feeding utensils and feed by flies.

3. The infant should be protected from unnecessary exposure to colds and respiratory infections by the mother or nurse wearing a mask at any suspicion of the onset of a cold in herself.

4. In very hot weather, when the feed is taken reluctantly, the infant should not be unduly urged, but a liberal amount of plain boiled water should be offered between feeds or in place of the occasional bottle.

VOMITING

Nearly every infant is inclined to posset or spit up a few teaspoonfuls of his feed, usually immediately after the feed is finished. This may be due to slight over-filling of the stomach or may occur during the eructation of wind.

Vomiting may be due to:

Obstruction of the Gastro-Intestinal Tract

Oesophageal atresia, duodenal atresia, atresia of the intestine or imperforate anus will all cause vomiting commencing soon after birth. The higher the obstruction the sooner the onset of vomiting. Persistent bile-stained vomiting beginning soon after birth should

rouse suspicion that there is an organic obstruction in the intestinal tract.

The commonest obstructive type of vomiting met with after the second week is:

Congenital Pyloric Stenosis. This condition is characterized by large projectile vomits, marked constipation and loss of weight. In many cases dehydration is present. The infant is hungry and typically has an anxious look.

The disease is eight times as frequent in boys as in girls and is most commonly found in the first child. Second cases in a family occasionally occur. The incidence is about 1 in 300 births.

The onset is generally between the second and sixth week, but is sometimes later. It is very rare for vomiting due to Congenital Pyloric Stenosis to commence in the first week—vomiting at this time being due to other causes. (See below.)

The diagnosis is made by observation of waves of peristalsis passing from left to right across the epigastrium and by palpation of the pyloric tumour. This can be felt in the upper right quadrant of the abdomen—just outside the right rectus. It feels like a small nut and can be felt to contract and relax under the examining finger.

Treatment

(*a*) *Medical.* Tihs consists of daily gastric lavage with normal saline, small frequent thickened feeds, and administration of antispasmodics. Atropine or Belladonna used to be given, but Eumydrine (Atropine metho-nitrate) is less toxic. This may be given as a 1 in 10,000 solution (Dose 2–5 c.c.), as a lamella (Pylostropine gr. 1/750) dissolved under the tongue, or in a 0.6 per cent solution in 90 per cent alcohol (Dose 2–5 minims). This latter is absorbed from the mouth.

Medical treatment is most suitable for the case of late onset since the symptoms disappear spontaneously at sixteen to eighteen weeks of age. It should not be continued for longer than a week if no improvement occurs.

(*b*) *Surgical.* This is the treatment of choice since it results in an immediate cure. In Rammstedt's operation the thickened pyloric muscle is split longitudinally down to the mucosa which bulges through the incision.

The post-operative treatment has changed considerably. Twenty years ago many cases coming to hospital were in a state of advanced marasmus with a severe gastritis and had to be treated post-operatively with very weak feeds.

The authors believe that in most cases restricted feeding after operation is not now necessary. Breast-fed infants are put to the breast six hours after operation, and thereafter at the usual intervals and allowed to take what they want. Similarly, bottle-fed infants are given their normal feeds. As a rule rather smaller amounts are taken for twenty-four hours.

Diluted feeds are only necessary in long-standing cases with severe gastritis and then only for forty-eight hours after operation.

Gastritis

Occasionally gastritis occurs in young infants. We have seen several cases due to staphylococcal infection. In one it was caused by frequent oesophageal feeding in a premature infant. The condition responds to daily stomach wash-outs. Bland fluids and dilute feeds should be given at first. When vomiting is severe, subcutaneous or intravenous fluids may be necessary. It should be strongly emphasized and should be taken as a cardinal rule, that acute gastritis is usually accompanied by diarrhœa (acute gastro-enteritis). See p. 114.

Vomiting during the first few days of life may result from the swallowing of liquor amnii which irritates the stomach and gives rise to the production of great quantities of mucus. A few stomach wash-outs with normal saline will clear up the vomiting.

Excessive Air-Swallowing—Aerophagy

The most frequent cause of vomiting in the first few months of life is excessive swallowing of air. All infants swallow a certain amount of air during feeds, but if too much is swallowed the stomach becomes over-distended, and, if the baby is in the supine position, the air cannot escape easily and food is vomited to relieve the gastric distension. Sometimes a considerable quantity of air is eructated with the milk, causing an explosive type of vomiting which must be distinguished from the true projectile vomiting met with in pyloric stenosis.

Babies who are *underfed* and very hungry, and over-active hypertonic babies, are especially prone to develop aerophagy. They are often liable to have severe colic due to distension of the bowel by swallowed air.

The weight gain in such infants is poor, and they are usually constipated. Sometimes frequent green hunger-type of stools are passed.

The treatment of air-swallowing is:

1. Offer the infant a sufficient supply of food for its needs. (See Chapter Four.)

2. See that he is able to get this food easily and by making the hole in the teat of adequate size enable him to take the feed in ten to fifteen minutes at the most.

3. Hold the infant up for twenty minutes after feeds so that he may 'break the wind' without at the same time bringing up the food with it. In severe cases the baby should be held up to break wind halfway through the feed. Propping the baby up in a semi-upright position after feeds is also helpful.

4. Administration of ½–1 gr. of Chloral fifteen minutes before feeds will usually stop the baby gulping down air at the beginning of a feed.

Parenteral Infection

Vomiting frequently occurs in infants at the onset of an infection such as otitis media, naso-pharyngitis or acute pyelitis. The vomiting is often the presenting symptom and may lead to the doctor thinking that the primary cause is in the gastro-intestinal tract. In young infants suffering from whooping cough, vomiting is often severe and as there is usually no whoop, diagnosis may be difficult. The paroxysmal nature of the cough and history of exposure will aid in the diagnosis. A small substitute feed should be offered a quarter of an hour before the regular meal; such a feed often induces the paroxysm of vomiting and allows the child to retain its ordinary meal given immediately afterwards.

Hiatus Hernia

In this anomaly part of the stomach, varying from a small pouch to as much as a third of the stomach, herniates through the

oesophageal opening of the diaphragm into the thorax forming a sliding hernia. The hernia is probably present at birth. The widening of the hiatus is thought to be the primary lesion. As a result the normal sphincter mechanism of the cardiac orifice is destroyed. The oesophagus enters into the stomach in a direct line instead of at an angle. Free reflux of the stomach contents into the oesophagus occurs. Ulceration of the lower end of the oesophagus is common.

The symptoms are vomiting and failure to gain weight. The vomiting commences in many cases in the first few days of life, and is often very forcible so that a diagnosis of congenital pyloric stenosis may be made. The vomit may occur during the feed and shortly after. The vomiting continues for the whole of infancy. It usually contains much mucus and at times altered blood. Occasionally haematemesis or melaena may occur. Because of the loss of food the infant is slow to gain weight but rarely loses except in the severe cases.

Diagnosis can be made in most cases by a barium swallow but oesophagoscopy may be necessary.

Treatment consists in keeping the baby in the upright position day and night. This is difficult to accomplish by pillows as the infant slips down. A specially constructed box, which may be tilted to various degrees is very convenient and the baby is soon able to sleep in the box.

In many cases the vomiting becomes less frequent in the second year of life when the baby learns to sit and walk. It may be necessary, however, to keep the baby sitting up at night until the age of three years. Although the symptoms disappear, the hernia remains and can be demonstrated radiologically.

In more severe cases vomiting is persistent and there is much oesophageal ulceration which may lead to stricture formation. Loss of weight occurs. Surgical intervention is necessary. A thoracotomy is performed and the stomach replaced and fixed in the abdomen.

Nervous or Habit Vomiting

This type of vomiting tends to start about the third or fourth month at the onset of mixed feeding. The infants are often excitable,

restless and over-active. They often sleep badly. The mother is usually over-anxious. In spite of the vomiting, sufficient food is usually retained to enable the weight to be maintained and, in some cases, the infant may actually gain weight. Infants suffering from habit vomiting may develop rumination (see below). Providing there is no loss of weight, no treatment is necessary. When the weight, however, is stationary, or there is an actual loss of weight, thickened feeds should be given, Benger's or some similar food being added to the milk to make a really thick mixture. Nestargel[1], a Swiss preparation obtained from Caroub seeds, imparts a glutinous consistency to milk. Such a feed is extremely difficult to vomit. It has been found of considerable use in the treatment of habit vomiting. Half to two per cent of the preparation is added to each feed. Sedatives are often helpful; one to two grains of Chloral hydrate should be administered fifteen minutes before each feed.

Rumination

This habit may develop at any time after the second or third month. Infants are similar in temperament to those who are habit vomiters. The infants are able to regurgitate the food into the mouth where it is re-tasted, some being swallowed and some being ejected. The infant may sometimes be observed to vomit by putting his finger into his mouth. Before the food is brought up the baby makes grimacing and gulping movements, working his jaws backwards and forwards, arching his back and stiffening his body. The habit may persist throughout infancy. In many cases a state of undernutrition results. The treatment of rumination is often very difficult. The administration of sedatives before feeds and thickening of feeds with cereals may stop the rumination. (See Table XIII.) The addition of Nestargel to the feeds has been successful in a number of cases. Various mechanical devices have been invented to fix the lower jaw after the feeds have been taken, e.g., a bandage or crepe bandage with attached tapes which can be firmly tied under the jaw. They are not always successful and there is a definite tendency for the baby to vomit and aspirate the food.

[1] Made by Nestlé.

TABLE XIII

THICK FEEDS

(Suitable for under-weight infants who ruminate)

The requirements per feed and for the twenty-four hours are given in the following table.

Using Full-Cream Dried Milk (National Dried Milk, Full-Cream Cow & Gate, Ostermilk No. 2, etc.) with Savory and Moore's Food.

Individual Feeds						Total for 24 Hours					
Expected weight lb.	F.C. dried milk measures	Amt. of water oz.	Level teaspoons of sugar	Level teaspoons of S & M	No. of feeds in 24 hrs.	F.C. dried milk measures	Amt. of water oz.	Level teaspoons of sugar	Level teaspoons of S & M	No. of feeds in 24 hrs.	Size of each feed oz.
10	4½	6	1½	1½	5	22½	30	6½	6½	5	6
11	5	6½	1½	1½	5	25	33	7½	7½	5	6½
12	5½	7	2	2	5	27½	35	8	8	5	7
13	6	7½	2	2	5	30	38	8½	8½	5	7½
14	6½	8	2½	2½	5	32½	40	9½	9½	5	8
15	7	8½	2½	2½	5	35	43	10	10	5	8½

Allergy

Rarely severe vomiting may arise in infancy as a result of cow's milk, egg white or other antigens. A small proportion of infants are extremely allergic to cow's milk though this is undoubtedly rare. Vendal[1] found a total of twenty-three cases of idiosyncrasy to cow's milk treated at the four Children's Hospitals in Stockholm in the years 1919 to 1947. In one form, severe vomiting may occur three or four hours after the administration of the milk, even though very small amounts may be given. In the other group, urticaria or asthma may appear within a few minutes of ingestion. In mild degrees of allergy a slow desensitization may be produced by giving gradually increased quantities of cow's milk. In more severe cases it may be necessary to give another type of milk, e.g., goat's milk or a synthetic milk made from soya bean flour, with added fat and minerals (Mullsoy or Soyac). After the age of one year it is usually possible to get the baby gradually on to cow's milk.

[1] Vendal. S. Acta. Paediat. 1948. Suppl. 5.

Mechanical Vomiting

This is due to stimulation of the back of the pharynx and uvula, with consequent retching. Pus from the adenoids may produce retching and straining. Treatment of the original cause will clear up the vomiting.

Cerebral Vomiting

This is seen in brain tumour and meningitis. In such cases the vomiting is unrelated to meals. Cerebral tumour should always be suspected in a child who vomits without cause. Localized signs are late in developing, but there may be evidence of raised intracranial pressure, such as papilloedema. The sutures generally separate in infancy because they are not joined and consequently the intracranial pressure may not be as great as in older children.

Toxic Vomiting

Vomiting may occur as a result of uraemia secondary to congenital abnormality of the renal tract. Vomiting may also be due to excessive doses of ipecacuanha.

Vomiting in Older Children

Acute illnesses, notably Scarlet Fever, Lobar Pneumonia and acute Pyelitis are ushered in by vomiting. An attack of severe vomiting may be due to eating indigestible food, unripe food, etc., the so-called 'green apple' type of vomiting. The food gives rise to intense irritation of the stomach, profuse vomiting occurs, the tongue is furred and there is almost complete anorexia. Dehydration may occur but usually recovery is quick. The child at first can only keep down small amounts of fluid, after which he can gradually be got on to an ordinary diet. Vomiting is an early sign of intestinal obstruction in childhood, as the small intestine is usually affected. Intussusception and Volvulus are examples of this type of vomiting. Periodic severe vomiting may occur when there is mal-rotation of the large intestine. This is usually associated with a universal mesentery. The caecum is situated below the transverse colon and fibrous bands pass across the third part of the duodenum to the lateral abdominal wall. Intermittent obstruction of the duodenum occurs. The condition may be diagnosed by

barium meal, which shows up the distended proximal part of the duodenum and the abnormal rotation of the intestine. Cerebral Tumours will cause persistent vomiting in children through rise in intracranial pressure. Three-quarters of the Cerebral Tumours of children are below the tentorium, either in the cerebellum or pons, and many of these will obstruct the Aqueduct of Sylvius. In most of these cases papilloedema occurs early. Reflex vomiting may be caused by certain conditions which stimulate the gag reflex, for instance chronic sinus infection, in which there is a copious naso-pharyngeal discharge. Some children vomit more easily than others from irritation of the naso-pharynx.

Vomiting from psychological causes is not uncommon in highly-strung and sensitive children. It may be brought on by emotional disturbances of various kinds. Children who are afraid of going to school may vomit regularly every morning at breakfast time, although at week-ends or during holidays, there is no vomiting. Such children may need treatment by a child psychiatrist. Cyclical or recurrent vomiting is a common syndrome in young children. It usually starts at the age of two years onwards and may occur at intervals of two or three months. It may be precipitated by some mild infection, by over-excitement and in some cases, by a diet over-rich in fat. Abdominal pain and sometimes diarrhœa is associated with the vomiting. The stools are often pale. Some of these children after the age of five or six, have headaches and develop typical Migraine. No satisfactory explanation of the syndrome has been given. The presence of ketonuria does suggest that there is a temporary disturbance of the carbohydrate-fat metabolism. Treatment consists of administration of small drinks of water, containing 5 per cent glucose. Barley sugar may be given to suck but it is unwise to give any solid food until the vomiting has ceased. In most cases it is difficult to prevent the attacks coming on, but sometimes limitation of the fat intake diminishes their frequency. In most children the attacks become less frequent from the age of six or seven years.

COLIC

The term colic in infancy is applied to gastro-intestinal spasm and may be caused by over-distension of the bowel or forcible

peristaltic contractions. Distension of the intestine is usually due to swallowed air. Carbon dioxide which is the main product of intestinal fermentation is absorbed relatively quickly whereas air tends to pass through the gut unabsorbed.

Aerophagy is frequently due to underfeeding. The hungry baby sucks vigorously when given the bottle and tends to swallow excessive amounts of air. Moreover, he constantly is sucking his fingers or thumb and swallows more air. This is not eructated, but passes through into the intestine. The abdomen is often much distended and considerable amounts of air are passed per anum. The infant starts crying from colic about half an hour after being given the feed and may scream for most of the time between feeds, drawing up his legs and holding himself tense during paroxysms.

There is a type of baby who suffers constantly from colic and flatulence even though given an adequate diet. They are usually restless during feeding and generally over-active. They often vomit part of the feed. Diarrhœa due to increased peristalsis may be present. It has been suggested that such infants have an instability of the autonomic nervous system, causing hypermotility of the intestinal tract. These babies often develop into the 'highly-strung' type of child. One or other parent or both may be of a similar temperament.

Colic is commoner in the first three or four months of life and tends to diminish when mixed feeding is commenced and the baby is taken off the bottle. Cup or spoon feeding should be instituted as early as possible. Some infants will go on swallowing air up to one year of age or later.

Treatment

Prevention of colic is easier than the relief of the attacks. Firstly, the adequacy of the feeding should be gone into. If breast-fed, a period of test feeding should be carried out. At least 3 oz. and 55–50 calories per pound of expected weight should be given daily. It may not be possible to give this feed at once if the baby has been underfed, but the amount should be gradually increased to the required quantity. It may be necessary to complement the breast feeds. Artificial feeds should not contain excessive amounts of fat or carbohydrate.

Commonly infants suffering from colic have had frequent changes of food. It cannot be stressed too strongly that colic will occur independently of the type of food given, as the cause is a mechanical one due to aerophagy. An infant should not be taken off the breast because of colic, unless the breast-milk supply is definitely inadequate.

Often colic is thought to be due to dyspepsia, especially when vomiting is present; the feeds are reduced, which merely exacerbates the symptoms. The infant needs more not less food.

The simple increase of the feeds to an adequate level will abolish colic in many babies. A boat-shaped bottle should be used, or an upright bottle with a valvular teat. The hole in the teat should be of adequate size, so that the infant can obtain the feed without difficulty. Other babies require sedation to prevent gulping of the feeds. Chloral gr. ½–1, fifteen minutes before feeds will usually quieten a restless infant. Occasionally small doses of phenobarbitone gr. 1/12 to 1/8 are justifiable.

In the hypertonic infant with excessive motility of the gastro-intestinal tract, atropine preparations are useful. This is best given as atropine metho-nitrate (Eumydrine) and may be administered before feeds in the same doses as in pyloric stenosis (see p. 118).

During the attack attempts should be made to get up the wind by holding up the baby as described on p. 94. Changing the position of the baby, massaging the abdomen or the application of external heat, e.g., a hot-water bottle, will often shift the air and enable it to be passed per anum. If the abdomen is very distended a rectal tube may be passed. Carminatives are of little value in the relief of colic.

CONSTIPATION

Constipation is more common in the bottle-fed than in the breast-fed infant. The relatively large amount of casein in cow's milk tends to produce a higher proportion of insoluble calcium soaps in the bowel when ordinary amounts of fat are present in the diet. This causes the bowel contents to move much more slowly through the intestines. Bottle-fed babies pass fewer stools than breast-fed infants for this reason. If babies are receiving small amounts of carbohydrate, constipation is even more likely to

occur, owing to the reduction of fermentation of carbohydrate in the intestine. The remedy is to increase the amount of carbohydrate and, if necessary, to reduce the amount of milk protein. Some breast-fed infants are, however, very constipated. They may not pass a motion more often than once a week. Usually, however, the motions are soft and cause no disturbance to the infant. The constipation tends to persist until supplementary foods are added to the diet. Other causes of constipation in infancy are:

1. *Underfeeding:* This is often not diagnosed in breast-fed infants until it is noticed that the baby fails to gain weight. A series of test feeds will quickly demonstrate that the baby is being underfed and small complementary feeds will both correct the constipation and at the same time cause the infant to gain weight. In the case of bottle-fed babies a calculation of the food requirements will demonstrate whether the baby is having adequate feeds or not. The feeds should then be increased to the required amount and, if necessary, extra sugar should be added.

2. *Shortage of Fluid:* Babies fed on whole milk tend to be short of fluid and may, therefore, become constipated. Care should be taken to see that the baby receives at least 3 oz. of fluid per pound of body weight daily.

In very warm weather, an ounce or two of boiled water may well be given to the infant between feeds with or without fruit juice.

3. *Fear of the act of defaecation.* The anus may be torn or split (anal fissure) whilst the infant is passing a large, constipated motion; streaks of blood are often found in the motion. This causes the infant to associate the act of defaecation with pain, and this may become so fixed in the infant's mind that he is frightened to pass a motion. A liberal supply of Witch Hazel Ointment (Ung. Hamamelidis B.P.) should be pressed well into the anus with the tip of the little finger, before and after a motion, for two or three weeks. The motions should be kept soft meanwhile by the administration of Petrolagar Emulsion or Milk of Magnesia.

4. *Failure to establish the defaecation reflex* through faulty management from early infancy. The infant should be placed on a pot at regular intervals at certain times of the day, preferably after meals, to establish regularly the defaecation reflex. Care,

however, should be taken not to 'over-pot' the infant. There is a tendency to do this in early infancy and quite frequently it results in delay in establishing the reflex. Probably few babies, before the age of three or four months, are able to develop the necessary reflex.

5. ***Congenital Abnormalities.*** In Hirschsprüng's Disease, constipation appears in early infancy and becomes progressively more severe. Congenital anal stenosis occasionally occurs and also gives rise to severe constipation. Such children require dilatation of the anus.

6. ***Overweight, Flabby Infants.*** These often lack the strength in the abdominal muscles to expel the motion. A high protein low carbohydrate diet should be given. Abdominal massage is helpful.

Symptoms

The symptoms of constipation, contrary to popular belief, are few and general disturbance of health rarely occurs. The passage of large formed motions may be painful and may be associated with the passage of blood. Constipation tends to produce symptoms of anxiety in parents, who have been brought up to believe that it gives rise to toxic absorption and interference with the infant's health. Reassurance of the mother on these points is often necessary.

Treatment

Laxatives should be avoided as much as possible. It is often possible to correct constipation in young infants by adjustment of the diet, e.g., by giving more carbohydrate and less protein. Instead of the added sugar, one or two teaspoonfuls of Extract of Malt may be given in each feed. This is the most laxative of all carbohydrates. Fruit juices, especially prune juice, are useful. After three to four months, vegetables may be given; the constipation often clears up after these foods are introduced.

The institution of regular habits has been mentioned by means of early training. Should these measures not be sufficient, mild laxatives may be given, but should be discontinued as soon as possible. Enemas should not be used as a routine, nor should suppositories, though there is no objection to the occasional use of a soap stick or glycerine suppository. The most useful laxative

in infancy is magnesium hydroxide; it acts as a hydragogue, the magnesium hydroxide being partly converted into magnesium chloride in the stomach. In the dose normally used, namely ½–2 teaspoonsful daily, it is a harmless drug.

Mineral oils are frequently employed. Liquid Paraffin renders the stools soft, but has the disadvantage that it interferes with the absorption of Vitamin 'A'.

Petrolagar Emulsion is free from this disadvantage. If an anal fissure is present, the stools should be kept soft at least for ten to fourteen days after the fissure has healed.

Constipation in Older Children

This is usually the result of faulty habits of defaecation over a prolonged period, though this is not the only cause. Faulty diet plays a relatively unimportant role, though lack of fresh fruit and vegetables, insufficient food and too little exercise, may be contributory causes. In many cases, the origin of constipation dates from the toddler period; it may be the result of faulty training and an inadequate supervision of the child's bowel actions. Often a child has developed an anal fissure which, because it gives rise to the passage of painful motions, leads to the child holding back the stool and not properly emptying the bowel. Sometimes negatavistic children hold back their motion and refuse to defaecate regularly. A similar train of events may occur in the mentally defective, who does not realize or respond to the usual stimulus to defaecate. The end result is similar, whatever the original cause of the constipation may have been. The rectum, sigmoid colon and later the descending colon, become distended with faecal material which becomes hard owing to the absorption of water. The distension of the colon results in the loss of tone. Moreover, the rectum loses the stimulus for defaecation and permits a large volume of faeces to remain in the rectum. The child may actually pass a stool fairly regularly, but this is merely an overflow from the overloaded bowel. Actual overflow incontinence may occur in long standing cases. Secondary psychological disturbances often arise in these cases, because of the excessive anxiety of the parents and their concentration on the child's bowel habits. Such children are often referred to the psychiatrist. On examination of the

abdomen of such a child, large, hard faecal masses can be felt in the pelvis and in the descending colon. On rectal examination, the rectum is found to be full of faeces right down to the anus. Chronic constipation of this severity rarely causes ill-health. There may be some abdominal discomfort and colicky pain. Fissures of the anus, piles and prolapse may occur as a result of straining. As mentioned above, psychological symptoms are probably more important. The child may develop feelings of guilt and anxiety as a result of the attitude of the parents towards the constipation. These symptoms disappear rapidly when the constipation is cured.

Treatment

In early cases constipation can generally be corrected by the administration of laxatives together with an emulsion which softens the faeces, e.g., Liquid Paraffin or Petrolagar with the addition of Milk of Magnesia and Phenolphthalein. Senna or Cascara may be administered if a stronger purgative is necessary. In severe cases it is essential to clear out the faecal masses from the colon by means of high colon washouts. These may have to be given daily or on alternate days, for two or three weeks, and less frequently for several weeks longer. Occasionally, manual removal of hard masses is necessary. Once the colon is emptied, purgatives should be started. The distended colon gradually contracts down and recovers its normal tone, but this may take several months. Stephens[1] and his co-workers who did much to clarify this syndrome have employed the following mixture in a large number of cases, and the authors of this book have also found it extremely useful.

Neostigmine Bromide mgs. 10
Magnesium Sulphate grs. 20
Petroleum Emulsion (50 per cent) minims 60
Water to 2 drachms

Neostigmine stimulates the intestinal muscle, magnesiun sulphate acts as a hydrogogue and the liquid paraffin softens the faeces. Two teaspoonfuls of this preparation are given two or three times daily, the dose being gradually reduced as the bowel action is established. It may be necessary, however, to continue treatment

[1] Bodian, M., Stephens, F. O. and Ward, B. C.: (1949) *Lancet*, 1, 6.

for a considerable time in long-standing cases, as relapses may occur. While treatment on these lines is carried out, re-education of the child so as to establish normal bowel movements should be instituted. A diet containing ample residue should be given. Abdominal massage is also of value.

THE STOOLS IN INFANCY

The character of the stool depends on the food ingested. Too great reliance should not be placed on its appearance. Infants are sometimes kept on a starvation diet until the stool becomes less green and assumes a yellow tint, but this shows a total lack of understanding of the problem, as until a feed is given nothing but unchanged bile will be passed and the stool will remain green.

The Normal Stool

Breast-fed Infants. Immediately after birth three or four dark green, or almost black, tarry stools, composed of meconium are passed. These contain bile, intestinal *débris*, shreds of skin and hair, the latter having been swallowed with the amniotic fluid. As the child commences feeding, first on colostrum and later on normal breast milk, the stools become lighter in colour. They are of a salve-like consistency, and the colour is now golden yellow or mustard colour, having a slightly acid or sour smell which is not offensive. They are acid in reaction to litmus paper. The number of stools tends to decrease, so that by a month there may be three, and by two months about two stools per day. The colour and odour remain the same, although the consistency tends to become more solid.

Artificially-fed Infants. The normal stool of the artificially-fed infant is different from that of the breast-fed infant, and varies with the feed given. Feeds high in protein or high in fat produce different stools from skimmed-milk feeds or lactic acid milk feeds. Each of these stools, however, is normal for the particular feed. On the whole, the artificially-fed infant's stools are similar in quantity and fewer in number than those of the breast-fed infant. They tend to be less yellow or mustard-coloured, being paler and more formed. The odour is more offensive and there is a tendency for the stools to be alkaline to litmus.

High protein feeds, or feeds containing much undiluted cow's milk, produce grey, offensive, alkaline motions, which are constipated or crumbly. *Starchy or sugary feeds* tend to produce less formed motions with a more acid reaction to litmus, and give a slightly more yellow or brown colour to the motion. *Malted* foods give a definite chocolate tint to the motion. *Buttermilk* or butter-milk mixtures produce stools of a shiny olive-green, with a characteristic odour.

Reaction of the Stools

Strongly acid stools are due to an artificial feed excessive in fats or carbohydrates.

Alkaline motions tend to be formed in character, and are due to an excess of protein in the diet. Whole skimmed milk or an excess of a skimmed dried milk with a deficiency of carbohydrate tend to produce such a stool.

Stools may be passed acid, but become alkaline on standing, or *vice-versa*, and should, therefore, be tested immediately after being passed.

Colour of the Stools

Occasionally a stool is passed golden-yellow and on standing becomes bright green. This is due to oxidation of the bile constituents, and is of no particular importance. Scraping beneath the green surface, it will be found that the interior of the stool is yellow.

Green Stools. The green colour of a stool is due to the presence of bile. Bilirubin and Biliverdin are the pigments most usually found. If peristalsis be increased for any reason, such as over-purging or some bacterial infection of the bowel wall, and the intestinal contents be hurried along, preventing the proper change from the green to the yellow pigment, then one must expect green stools. In the so-called hunger stool, well seen in pyloric stenosis little else than bile and the bacterial *débris* of the intestine is to be found. Such a stool is dark olive-green. Feeds low in fat tend to produce greenish stools. Fat, when present, gives the stool a lighter and slightly yellower colour. The green acid stools of fermentative diarrhœa are not directly related to the presence of

sugar, but to the increased peristalsis of the bowel, consequent on the excessive acid production.

Grey Stools. These are usually the result of high fat feeding, and they may be semi-formed or formed and crumbly. A high proportion of soap will be found in such stools. With a continued excess of fat the reaction becomes more acid and the grey colour disappears as peristalsis is increased, yellowish curds and a green, bile-coloured stool resulting. In coeliac disease the stools are large, offensive-smelling, grey or putty coloured and semi-formed. An analysis of such stools shows that a total of more than 30 per cent of the dried stool is fat, which is chiefly in the form of soaps.

White Stools. These are due to a great excess of fat or an absence of bile. The classical example is that of the jaundiced child, especially in cases of congenital obliteration of the bile ducts.

Black Stools. These may be due to the presence of blood and are described as tarry. They are well seen in melaena neonatorum. Drugs such as bismuth, iron or charcoal also give rise to dark or black stools.

Abnormal Constituents in the Stools

Curds. It is usually assumed by the general public that all curds are casein curds. The curd most often found in stools, however, is composed almost entirely of fat caught in the meshes of a small proportion of casein. Such curds are soft and easily broken up. If placed in ether they tend to dissolve. These are the common curds of the infant's stool, whether it is breast fed or artificially fed. With the use of a lower fat feed such curds tend to disappear.

True protein or casein curds are relatively uncommon, unless the milk given is unboiled. They are large, bean-shaped, and have a brownish, semi-translucent appearance. When placed in ether they do not dissolve, and with formalin they become hard and tough. They sink in water. Protein curds can be abolished by the addition of cereals to the feed, by boiling the milk and by other methods of modifying the casein (see p. 72).

Blood. Blood in the motions is most commonly due to an anal fissure, caused by constipation. In such cases the blood is smeared on the outside of the formed motion. Clots of blood or dark, tarry motions in the new-born infant suggest melaena neonatorum.

In older infants the red currant jelly motion, together with spasms of pain, suggest intussusception. In mucous colitis the blood present is in small flecks mixed with much mucus, rather than large clots. Dysentery and rectal polypi are also cases of bleeding in children.

Mucus. A small amount of mucus is normally present in the stool. Mucus in excess in the motion suggests irritation of the bowel. If it is intimately mixed with the stool it is probably from the small intestine, whereas when clinging to the surface of the motion it is more usually from the colon. Catarrhal inflammation (Mucous Colitis) may give rise to excessive production of mucus, which is also present in Sonne Dysentery.

Pus. Pus is present in severe inflammation of the bowel, e.g., ulcerative colitis. Shreds of mucous membrane are found with it in mucous colitis.

Worms. Thread worms, round worms and segments of tape worms are the usual varieties found in the British Isles. There are usually many thread worms present at one time, and they can be seen moving like tiny white threads from $\frac{1}{4}$–$\frac{1}{2}$ in. long. Round worms are similar to the ordinary worm found in the soil but thinner, and segments of tape worm are oblong and white, and about the size of the little finger nail. The presence of worms in a stool should be easily observed by any intelligent person on examination.

Undigested Vegetables. Such vegetables as spinach, sprouts and carrots are readily seen in the motions of infants or young children. The giving of vegetables should not be abandoned, however, because of this normal occurrence.

CHAPTER EIGHT

WASTING IN INFANCY AND THE PREMATURE INFANT

WASTING—(Malnutrition or Marasmus)

MARASMUS IS A term which is better discarded. It has come to mean in the past a more or less specific syndrome whereas it really is a descriptive term for a clinical condition which may have several causes. Malnutrition is probably a better term.

Malnutrition may be of varying degrees, from a slight deficiency in weight to gross undernutrition in which there is little or no subcutaneous fat, the infant presenting a skin and bone appearance.

Effects of Malnutrition

If the calorie value of the food is lower than the basal heat output, destruction of body tissue occurs. The fuel requirements are met by the burning of fat, carbohydrate and eventually protein.

The fat in the subcutaneous tissues and elsewhere is metabolized to provide energy, if the amount of available carbohydrate is insufficient. This utilization of stored fat causes the emaciation of the infant, the wrinkling of the skin and the sinking-in of the eyes.

In more advanced cases of malnutrition the fat stores become exhausted and the protein of the muscles and other organs and of the blood are drawn upon for fuel. The destruction of blood protein results in a reduction in the plasma protein and a loss of blood volume, which gives rise to a sluggish circulation. This affects all the organs, especially the gastro-intestinal tract, so that absorption of food is impaired and further loss of weight occurs. Moreover, these very undernourished infants have a poor resistance to infections which tend to become chronic. Such infections further reduce the power to absorb and utilize the food.

Undernutrition is caused either by:

(*a*) Some gross congenital defect or organic disease, such as an infection, which interferes with the utilization of food.

(*b*) Insufficient food intake.

(*a*) **Congenital Anomalies.** In *Cyanotic heart disease*, the infant

often grows and puts on weight slowly. There is imperfect oxygenation of the blood and this interferes with metabolic processes.

Disturbance of metabolism occurs in severe *anomalies* of the renal tract (such as urethral valve or bilateral hydronephrosis or polycystic kidneys). The blood urea in these cases will be high.

Severe *Intracranial defects* such as porencephaly are often associated with defective nutrition, usually because the infant will not take his feeds properly. In such cases tube feeding for some time is often necessary. In severe cases of *cleft palate* and *hare lip*, feeding is often extremely difficult and the infant may gain weight very slowly. Micrognathia, i.e., severe under-development of the lower jaw may be associated with cleft palate. Owing to the difficulty in feeding the nutritional state is very poor.

Congenital Pyloric Stenosis was once a common cause of severe malnutrition because of the severe vomiting. Diagnosis is now made much earlier and it is rare to see such grossly marasmic infants.

Fibrocystic Disease of the Pancreas usually presents as failure to thrive in the early months of life in spite of an adequate food intake. The infant is in fact very hungry. The stools are generally loose, rather frequent and very offensive. The baby may also have recurrent bronchitis or a persistent spasmodic cough. Diagnosis is made by intubating the duodenum and testing the duodenal juice for the presence of trypsin. In almost all cases tryptic digestion is completely absent.

Occasionally a baby suffering from *Fibrocystic Disease* of the *Pancreas* will continue to thrive until six months or even a year. In these cases the disease may be confused with *Coeliac Disease* which generally begins about this age. Examination of the duodenal juices will distinguish the two diseases.

Infections will result in a loss of weight due to poor appetite and the decrease in the secretion of digestive juices, which results in diminished absorption from the intestinal tract.

Acute infections such as otitis media, naso-pharyngitis, etc., have only a temporary effect on the nutrition of the infant and regain of weight takes place when the infection has cleared up.

Vomiting and *Diarrhœa* may be associated with acute infections

and may cause further loss of weight. Chronic infections, e.g., of the ears, chest, etc., however, may result in a progressive loss of weight.

Acute Gastro-enteritis usually results in marked loss of body tissue and the normal weight may not be regained for some considerable time.

In *Tuberculosis* on the other hand, the nutritional state often remains good until late in the disease.

(*b*) ***Underfeeding*** is the commonest cause of failure to thrive. Either the infant is not receiving an adequate quantity of food or there is not a proper balance between the various food constituents. Many breast-fed infants who fail to gain weight are not receiving an adequate food intake though this may be quite unsuspected until test feeds are done.

Bottle-fed babies are often underfed because of the fear of overfeeding. Underfed infants often vomit and have frequent green stools. This may be interpreted by the doctor as due to overfeeding and the feeds are reduced, leading to a still further degree of undernutrition.

Besides ensuring that the baby is receiving an adequate food intake for its *expected* weight (3 oz. per pound of body weight daily), the doctor should see that the food is a balanced one with sufficient but not too much protein and an adequate supply of sugar. Half-cream feeds which have a low calorie value because of their relatively low fat content should not be persisted in for too long. The change-over to full-cream feeds should be made when the baby reaches the weight of 10 lb.

The calorie value of the feed should be calculated. Infants will not thrive unless their energy needs are satisfied. An infant requires on the average fifty-five calories per pound of expected weight daily, slightly more in the first few months and slightly less towards the end of the first year.

An infant's diet should, therefore, contain sufficient fluid, adequate calories and a proper balance of the food constituents.

Besides providing such a food the infant must be able to get it from the bottle. This is often made difficult by the fact that the teat-hole is too small. The infant after a time becomes exhausted and fails to ingest all the feed. The hole in the teat must be made large enough, so that the infant can get the whole feed in ten to

fifteen minutes. Holding the baby up for twenty minutes to get his wind up is essential or he may vomit food with eructated wind between feeds.

Though the vitamins are essential for the well-being of the infant and to prevent rickets and scurvy, deficiencies in the intake of vitamins does not necessarily lead to malnutrition. Infants suffering from rickets, for instance, may be overweight though flabby and often anæmic.

Good hygiene is also important for the general welfare of a baby. Bad hygiene often goes with bad feeding. Insufficient fresh air will lead to loss of appetite. An infant in London especially should have at least five hours daily in the open air. The infant should be given adequate exercise and should not be swaddled with clothes so as to prevent proper exercise of the limbs.

The practitioner will make a grave error if he assumes that an infant in whom he has failed to detect any organic lesion, and who, after an adequate feed has been prescribed, still fails to gain weight, is suffering from some mysterious malady. In the majority of cases this is usually a matter of improving the hygiene and nursing care of the infant, and what appears to be a case of indigestion which fails to answer to any treatment, and which various feeds fail to rectify, will right itself without further change of feeding if a proper management of the infant be instituted. This may often mean the introduction of a nurse into the home, or a change of the existing 'Nanny'. In private practice, where the care and nursing of the infant are at their best, the failure to make a child thrive who is not suffering from gross organic disease is rare.

THE PREMATURE INFANT

The premature infant is defined as one born weighing 5½ lb. or less, whatever the period of gestation. A certain number of infants with a birth weight below 5½ lb. are, however, mature. Premature infants suffer from certain physiological handicaps, particularly if the birth weight is below 4 lb. There is difficulty in maintaining the body heat and the respiration is frequently irregular and shallow. The digestive system of small premature infants is unable to cope with large quantities of food and one of the main problems in feeding is to secure an adequate calorie intake.

Both Hess[1] and Mary Crosse[2] have pointed out the danger of overfeeding in the premature infant. Many infants have died of aspiration pneumonia in this early period because of vomiting. The latter author has consistently emphasized that so-called minimum feeding gives the highest survival rate and the least amount of abdominal distension, though the gain in weight is necessarily slow. Survival of the infant is the first principle. Weight gain is a secondary consideration.

Methods of Feeding

Mechanical difficulties may occur in feeding premature infants. Many of the larger infants will suck at a teat but it is necessary to use a smaller one than is usually employed for full-term infants. Special types of feeders have been made such as the Bell-Croy feeder (see Fig. 11), which are easier for the premature baby to suck from. The above feeder (made by Bell & Croyden) is a modified form of the American Breck Feeder. On one end there is a perforated rubber top similar to that of a medicine dropper; on the other end an ordinary teat used on infants' feeding bottles; this is not perforated. The glass barrel is filled with breast milk and by gentle pressure on the larger of the teats, the milk is expressed into the mouth of the infant with little or no exertion on his part.

A medicine dropper can also be used, the tip of the glass tube being protected by a short length of narrow rubber tubing. Small amounts of milk are squeezed into the mouth and are then swallowed by the infant.

Premature babies are rarely strong enough to feed from the breast and, in any case, the mother may not have much milk at first. Such milk as she has is expressed and given to the baby. If extra milk is needed it can be obtained from Queen Charlotte's Maternity Hospital, Ravenscourt Park, W.6.

If the infant cannot swallow, tube feeding must be employed. A small catheter (No. 3 or 4) is passed through the mouth into the oesophagus so that the tip lies about ½ in. above the cardiac sphincter. The length of catheter to be inserted varies with the

[1] Hess, J. M.: *The Premature Infant,* 2nd ed., 1949. Lippincott, Philadelphia.
[2] Crosse, Mary: *The Premature Baby,* 1946. J. and A. Churchill, London.

size of the infant. For an infant weighing 3–4 lb. the length of the catheter to be passed will be 5–6 in. This distance is marked on the catheter. Milk is allowed to flow in by gravity from a glass tube receptacle held about 7–8 in. above the head of the infant. After feeding the catheter must be pinched before withdrawal, so as to prevent aspiration of fluid into the larynx. Tube feeding must be carried out by a skilled nurse.

A method recently introduced has been found to be very satisfactory. This consists in passing a polythene catheter through the nose into the oesophagus just above the cardia. The tip of the catheter is sealed with paraffin wax and a number of small holes made in the side. The object of this wax is to prevent the sharp end of the catheter traumatizing the oesophagus. Such a tube is kept in for three or four days at a time. The feeds are given by a 20 c.c. syringe. The infant is hardly disturbed at all by this method of feeding.

Type of Food

Whenever possible, premature infants should be given breast milk, which is the most digestible feed. Unfortunately it is difficult to give an adequate calorie intake with breast milk alone. Moreover it contains too small an amount of protein. Premature babies, owing to their rapid growth, demand more protein than breast milk can provide. Because of the low level of muscular activity, the energy requirements are low for the first two or three weeks (45–55 calories per pound). They then rise steeply to as much as 70–80 calories per pound. (Equivalent to $3\frac{1}{2}$–4 oz. of breast milk per pound daily.)

After about two weeks therefore, it is a good plan to fortify the breast milk. Magnusson found when babies were fed on iso-calorie feeds of breast milk and breast milk plus casein hydrolysate, that the latter group gained weight more rapidly. Mary Crosse did not find that the addition of this preparation made much difference.

Casein, however, is well tolerated by the premature infant and up to 2 per cent may be added to the feeds. Probably the best preparation for fortifying breast milk is dried skimmed milk, which is very digestible and may be given up to a percentage of 5 per cent of the total intake.

When breast milk is not obtainable either from the mother or from any other source, some type of artificial food must be given.

Foods with low fat and protein and high sugar content have been used, e.g., Sweetened Nestlé's (55 per cent sugar) and Frailac (Cow and Gate) (77 per cent sugar). These are easily digested and infants gain weight well at first. Owing to their low protein content they should not be continued for more than three to four weeks unless casein or skimmed dried milk is added. Unsweetened evaporated milks and acidified milks (see p. 81) can also be used for the feeding of premature infants. All these feeds are given diluted at first, full-strength being reached about the fourteenth day.

Clement Smith introduced the practice of starving premature infants for the first day or two and it is now common practice to give neither food nor fluid for twenty-four to seventy-two hours after birth. The weight loss on this regimen does not usually exceed more than 7 per cent of the total body weight. The advantage is that the risk of vomiting is obviated and with it the danger of aspiration pneumonia. An expert nurse can generally tell when the infant requires feeding. He becomes restless and makes movements of the lips as though he is thirsty.

At first only a few teaspoonsful should be given at each feed, and the food (breast milk or artificial food) is given diluted to one-quarter strength. Gradually the amount and strength of the feed should be increased. By about the fourteenth day the infant (unless very small) should be having his estimated calorie intake. At no time should the feed be pressed to the point at which vomiting occurs. The feeding intervals will vary according to the size of the infant, and the volume of food taken. Infants under $3\frac{1}{2}$ lb. should be given two-hourly feeds by day and three-hourly feeds by night, that is 6 a.m., 8 a.m., 10 a.m., 12 noon, 2 p.m., 4 p.m., 6 p.m., 9 p.m., 12 p.m., and 3 a.m. If possible one of the night feeds should be omitted to give the baby a rest.

Those above $3\frac{1}{2}$ lb. can usually be fed less frequently viz., 6 a.m., 9 a.m., 12 noon, 3 p.m., 6 p.m., 10 p.m. and 2 a.m.

Variations in the amount of feed given and in the feeding times can be made by the sister-in-charge according to the sucking powers of the infant.

Hints on the Management of the Premature Infant

The following remarks apply to the infant with a birth weight of 4 lb. and over, who is being nursed at home. The domiciliary nursing of premature infants is possible if adequately trained health visitors are available for visiting the home at frequent intervals. Home rearing of premature infants has been successfully tried out in Bristol, Birmingham, etc. Babies who have reached a weight of 4 lb. can be sent home from premature baby units thus saving valuable cot space.

As a rule, premature infants under 4 lb. birth weight are best nursed in premature baby units in a maternity hospital where specially heated wards, fitted with humidifiers, or incubators are available. These small infants require special and constant medical and nursing care which is not available at home.

1. The temperature of the room should be kept between 70° and 80° F. depending on the size of the infant. The smaller baby requires a higher temperature. It is difficult to obtain this temperature by means of a coal fire. One or two electric fires are best. The cot itself is heated by hot-water bottles, changed frequently so that it should be possible to keep the temperature in the cot at 80°–85° F. A thermometer should always be kept in the cot to keep a check on the temperature.

2. It is essential that the infant be nursed in a humid atmosphere, as a premature baby does not thrive if the air is dry. The amount of moisture in the air can be increased considerably by keeping a pan or kettle boiling continuously over a gas or electric ring.

3. The cot used may be an ordinary treasure cot or failing this, a clothes basket or even a drawer from a chest of drawers may be used. This should be lined with quilting covered with a washable material with pockets at either side and at the foot to hold the hot-water bottles.

The head of the cot should be raised. This elevation of the infant's head facilitates the bringing up of wind and also tends to prevent the regurgitation of food.

4. Though premature infants may be nursed without clothes in incubators, in the home they require warm clothing. The baby is placed in a quilted cotton jacket made from cotton batting

covered with gauze. This jacket is folded over the baby and fastened at one side with safety pins and is provided with a hood to cover the head. Underneath the baby has a flannel vest opening in front and a soft napkin.

5. The baby should be disturbed as little as possible. He should not be moved from the cot for feeding or for washing and changing. Soap and water should not be used for the first few weeks, the skin being cleansed with olive oil. The infant should only be weighed every three or four days.

6. Since premature infants are extremely susceptible to infections, as few individuals as possible should come into contact with the baby. No visitors should be allowed. The nurse or persons handling the baby should wear efficient masks. If the nurse develops a cold or throat infection, she must be replaced. All feeding utensils should be scrupulously boiled and the nurse's hands carefully washed before handling the infant.

Particular care should be taken with the umbilicus which should be kept dry with a spirit or acriflavine dressing or a zinc oxide and starch powder containing 10 per cent sulphathiazole. Infants over 4 lb. birth weight are less liable to develop respiratory difficulties but an oxygen cylinder should be kept in the baby's room. If cyanotic attacks occur it may be administered by a small nasal catheter. This is more efficient than a face mask. The oxygen cylinder should have a fine valve adjustment and the oxygen should be pased through a water bottle so that the flow may be observed, and the oxygen moistened. An Oxygen Tent such as the Queen Charlotte's type can be fitted on to a cot or large basket.

7. Premature babies tend to bleed more easily than full-term infants and it is advisable to administer a Vitamin 'K' preparation in the first forty-eight hours to raise the prothrombin level in the blood. This is best given by injection. 10 mg. of a watery solution, such as Synkhavite is given for two or three doses. Oily solutions such as Kapilon must not be given, as they may cause necrosis of tissues or abscess formation.

8. Premature infants owing to their rapid growth require relatively large amounts of Vitamin 'D'. A total of 1,000 units a day should be given, starting not later than two weeks of age. Concentrated preparations are best.

9. To prevent nutritional iron deficiency anæmia, to which premature infants are especially prone, an iron preparation should be given from one month of age. Ferrous Sulphate is the best preparation and is given in doses of gr. ½ three times daily. Later the dose may be increased.

CHAPTER NINE

DIETS FOR SICK CHILDREN

In constructing diets for sick children it is necessary to consider the likes and dislikes of the child and also certain fundamental features such as palatability, appearance and texture, and the way the food is served.

Most children dislike strongly flavoured foods and object to sudden changes in their diet. New flavours and new kinds of food should be introduced slowly. The diet should be attractive and appeal to the eye. Colour is an important factor. Dull and uninteresting food is apt to be rejected by a child. Milk puddings should not be thick and stodgy but should be smooth, creamy and easy to swallow. Meat should be finely minced for young children. Fish should be flaked with a fork and mixed with some vegetables. Small quantities of food should be served. Second helpings can be given if necessary.

RECURRENT VOMITING ATTACKS IN OLDER CHILDREN

(So called 'Acidosis' or Bilious Attacks)

This is a common complaint amongst young children, starting at the age of two or three years. The attacks develop suddenly and vomiting may last from twelve to twenty-four hours. There may be abdominal pain. The attacks recur at irregular intervals, but on the average every two or three months. Ketone bodies appear in the urine in most cases, and in the more severe attacks, the child may become dehydrated and even comatose.

There is not really any satisfactory explanation of this syndrome. It is more commonly met with in the 'highly strung' type of child. The attacks may be brought on by fatigue, excitement, or the onset of an acute infection, although in many cases they develop suddenly without any obvious exciting cause. Nevertheless, the child should be examined carefully for evidence of any infection, e.g., otitis media, acute pyelitis, naso-pharyngitis, etc., or of any abdominal disease such as appendicitis, intususception or volvulus.

Treatment. During attacks the child should be confined to bed and given only small sips of water at frequent intervals. When this is vomited, all fluids should be withheld and small pieces of ice given to suck. Occasionally, it is necessary to give intravenous 5 per cent glucose in normal saline. No alkalis should be given since there is usually an alkalosis not an acidosis because of the loss of hydrochloric acid from the stomach.

Sedation will often control the attack. An injection of subcutaneous sodium phenobarbitone should be given in severe cases.

If an infection is present, this should be treated by a sulphonamide drug or penicillin, or the appropriate antibiotic.

Once the vomiting has stopped, the child may be given milk, diluted in small quantities at first, then a starchy preparation such as groats or Benger's. Normal diet can be given after two or three days.

It is common practice for children suffering from this complaint to be put on a low fat diet though there is little evidence in most cases of an intolerance of fats. The authors disagree with this as unwarranted and likely to interfere with the child's growth and nutrition.

NON-IRRITANT OR LOW RESIDUE DIET

Some young children have an irritable colon and will develop loose motions if much roughage is present in the diet. For such children, and those suffering from diarrhœa due to acute colitis (e.g., Sonne Dysentery) it is necessary to give a low-residue diet.

This type of diet may be prescribed for the dietary treatment of colitis and some types of diarrhœa. The aim of the diet is to provide a minimal residue of food in the colon.

Foods Allowed: Milk, cream, butter, eggs, ice cream, custard, plain jellies and milk shapes. Jelly jams and marmalade, honey, syrup, cocoa and plain chocolate, boiled glucose sweets and toffee. Crustless bread, plain cake and biscuits, cornflakes, well-cooked porridge made with fine oatmeal. Sieved bananas, sieved baked apple, and sieved cooked apricots, blackcurrant purée, rose-hip syrup, orange juice, Marmite, sieved tomatoes and cauliflower, purée of carrots and peas and potatoes. Finely minced lamb, rabbit, chicken and steamed pounded fish, finely grated cheese.

Foods to Avoid: Nuts, marmalade, and jam containing pips, seeds and skin. Salad and green leaf vegetables, e.g., cabbage, sprouts and spinach. Currants, raisins, sultanas, prunes, and figs. Wholemeal products, oatmeal biscuits and cakes. Fish bones, fried foods, pickles, spices, herbs, onions and shallots.

SCURVY

This is a deficiency disease, due to lack of Vitamin 'C' (see p. 167), the vitamin which is most commonly found in citrus fruits, fresh vegetables and summer fruits. It seldom occurs before the age of six months, and is found in artificially-fed babies. There is a tendency to bleed from the gums, which become greatly swollen and purple in colour; orbital and subperiosteal haemorrhages occur. Because of the latter, the limbs become acutely tender. The infant cries when picked up and is good when left alone.

Treatment. 3–4 oz. of orange juice or tomato juice daily will quickly produce healing of the scurvy. For children on a mixed diet, potatoes cooked in their jackets are a fruitful source of Vitamin 'C'. Ascorbic Acid—300 mgms. daily—may be given instead of the fruit juices. At the same time, the infant should be placed on a suitable diet for its age (see pp. 107–109).

The infant should be handled as little as possible until the scorbutic lesions have healed, which should take on the average about ten to fourteen days.

RICKETS

This is a deficiency disease due to lack of Vitamin 'D', leading to an imperfect calcification of the bones, most obvious at the sites of growth. Bending of the weight-bearing bones occurs.

Fortunately active rickets is extremely rare in the British Isles.[1] Prophylactic treatment consists of (*a*) seeing that the child is having an adequate diet for his age (see pp. 107–109); (*b*) that his intake of Vitamin 'D' in the form of cod-liver oil is at least one teaspoonful daily, or of halibut oil, four minims daily (about four drops); (*c*) every opportunity should be taken to expose the child's body to the direct rays of the sun.

[1] Reports on Public Health and Medical Subjects—No. 92. 'The Incidence of Rickets in War-Time'. 1944. H. M. Stationery Office.

It is necessary to give cod- or halibut-liver oil to all infants commencing at the age of two weeks, whether the infant be breast or artificially fed.

For the cure of rickets, much larger doses of Vitamin 'D' must be given, e.g., four to five teaspoons of cod-liver oil (1,500–3,000 units). These large doses may not be well tolerated and concentrated preparations should be given. In severe cases of rickets, even larger doses are necessary.

NEPHRITIS

The two forms of nephritis met with in children are:

1. Acute Glomerulo-nephritis (Haemorrhagic nephritis, Ellis's Type 1 nephritis). This usually subsides within a few weeks or months but a few cases become subacute and eventually chronic. Others develop chronic nephritis after a long latent period.
2. Nephrotic nephritis (Nephrosis—Ellis's Type II Nephritis).

1. Acute Glomerulo-Nephritis

Diet. In this disease there is generally oliguria and a temporarily raised blood urea. For the first three to five days, bland fluids only should be given, i.e., orange or lemon or Ribena drinks with glucose (at least 250 grams—9 oz. daily) but no milk. Fluids should be limited to a maximum of say 30 oz. daily according to the urinary output (invisible fluid loss is 15–25 oz. a day).

As this diet lacks protein, some loss of body protein occurs. After three to four days therefore, protein may be given (30–40 grammes daily). This may consist of milk, ice cream, eggs, rice, and bread. An egg may be given mixed with the milk, or lightly boiled. Thin slices of bread and butter may be given. The fat should not exceed 50 grammes daily but a high carbohydrate diet should be given to spare the breakdown of protein.

When the blood urea is normal, the total protein may be increased to 50–60 grammes, and fish and meat may be introduced into the diet. From this stage onward, a rapid return to normal diet is made even though microscopic haematuria may persist for months.

In subacute nephritis when the blood urea remains elevated, the daily protein intake of the diet should remain at the 30–40

gramme level and fish and meat should not be given. The carbohydrate intake should be kept high. Much the same diet is indicated for children suffering from chronic interstitial nephritis. The daily protein intake should not exceed 0.7 grammes per pound of body weight. Salt should not be added to cooking. The fluid intake must not be unduly restricted.

2. Nephrotic Nephritis

In this disease there is a considerable amount of oedema, massive albuminuria with a normal blood urea. As much as 10–20 grammes of protein may be lost in the urine daily. The total plasma proteins are reduced owing to the extremely low albumin level which is often below 1 gramme per cent.

Diet. Epstein has recommended a very high protein diet so as to keep the body in nitrogen equilibrium, e.g., 120–140 grammes a day. For young children 60–80 grammes a day are sufficient.

The diet should be low in salt. If the child can be kept on a negative sodium balance the oedema will not increase and may even lessen.

To give a diet containing less than 500 mg. of sodium a day, salt free bread and butter and a synthetic milk, free of sodium, must be given. (Trufood now make a low-sodium dried milk.)[1] Honey and jam contain very little sodium. Baking powder and baking soda must not be used in cooking, and salt must not be added to the food.

The following is an example of a low sodium containing diet:

LOW SODIUM DIET

	Sodium in Grams
Breakfast:	
5 oz. low sodium milk flavoured with tea (Edosol Trufood)	5.0
1 oz. of unsalted bread	2.0
¼ oz. of unsalted butter, or margarine	2.0
½ oz. honey or jam	2.0
1 egg	76.0
Dinner:	
2 oz. beef, mutton, chicken, or rabbit	50.0
3 oz. mashed potato unsalted	3.0
Average helping of unsalted green vegetable or salad	6.0
5 oz. custard or milk pudding made with unsalted milk	7.0
Helping of stewed fruit about 4 oz.	2.0

[1] Edosol.

Tea:	
5 oz. low sodium milk flavoured with tea	5.0
1 oz. unsalted bread	2.0
¼ oz. unsalted butter or margarine	2.0
½ oz. honey or jam	2.0
1 oz. unsalted cake or biscuit	1.0
Supper:	
5 oz. low sodium milk flavoured	5.0
2 oz. steamed plaice or 2 oz. chicken or rabbit	68.0
2 oz. mashed potato, ¼ oz. of unsweetened butter	2.0
Banana, apple or orange	—
	238.0 Grams
Total calories	1,418

Carbohydrate: 160 G. Protein: 60 G. Fat: 60 G.

Notes on Diet.—Honey, jam and glucose sweets contain low amounts of sodium and may be given as desired. The meat is calculated without bone. The synthetic milk may be flavoured with real fruit juices or coffee. Cow's milk is unsuitable as it contains 50 mgms. of sodium per 100 c.c. of milk.

Baking powder and baking soda must not be used in cooking and salt must not be added to any food; tinned soups, meats, and vegetables contain added salt and should not be used. Ordinary bakers' bread has a high sodium content; yeast prepared unsalted bread is used.

DIABETES

The dietetic treatment for a child with diabetes is too large a subject to be treated here in detail. For detailed information the reader should consult the special books devoted to this subject.

To-day diabetic patients are not so strictly dieted as they used to be, and in children it is important to give a diet adequate in calories so that the child can grow properly. It is not now the practice to weigh the fat and protein intake but many practitioners still limit the carbohydrate to about 50 per cent of a normal child's intake.

It has been the authors' practice for some years to give the child a 'free' diet, that is the diet for the normal child of the same age. The diet should be well balanced and should not contain excessive quantities of starchy foods or the child may put on too much weight. Sweets are restricted to three or four per day. The advantage of this diet is that the mother has not got to weigh the food, the child is happier when taking an unrestricted diet, and grows at the normal rate. Insulin is given in sufficient amounts to control glycosuria and hyperglycaemia.

Control of the diabetes does not appear to be more difficult than

when the child is having a restricted diet. Slightly more insulin may be required.

When the long acting insulins, e.g., Protamine Zinc Insulin, are given, the meals should be about equal in calorie value. A high tea instead of a simple tea should be given at 4.30 to 5 p.m. and a drink of milk at bed time, to prevent hypoglycaemia during the night. Increased exercise lessens the insulin requirements and under-exercise increases it. A child will get out of control even with a relatively slight infection such as tonsillitis or even the common cold, and increased doses of insulin may be necessary.

The urine must be tested at least three times daily and a chart kept. The child must be kept under close supervision so that the insulin can be adjusted if excessive glycosuria or hyperglycaemia occurs. Blood sugar estimations should be carried out from time to time.

OBESITY, OR THE OVERWEIGHT CHILD

Obesity is almost always due (except in certain rare diseases such as Cushing's syndrome and hypo-pituitary tumours) to excess of calorie intake over energy output. Obese children may not be voracious eaters but they are often sluggish and averse to taking exercise. The treatment of obesity consists in reducing the calorie intake while at the same time giving all the elements essential to maintain growth and health. It is not how much the child eats but how many calories are contained in what the child eats. The average amount of food which a child requires at various ages (as measured in calories) is shown in the following table:[1]

Age (in years)	Calories per day		Age (in years)	Calories per day	
	Boys	Girls		Boys	Girls
Under 2	900–1,200	900–1,200	9	2,450	2,150
2	1,400	1,450	10	2,500	2,350
3	1,650	1,550	11	2,550	2,300
4	1,800	1,700	12	2,600	2,350
5	1,750	1,700	13	2,750	2,500
6	1,900	1,950	14	3,050	2,600
7	2,150	2,050	15	3,400	2,550
8	2,200	2,100	16	3,100	2,350

[1] After McCance and Widdowson (see p. 178).

The calorie intake for the obese child should be reduced to two-thirds or even half of the average intake for the age. In view of the low fat intake extra Vitamin 'D' should be given.

As the obese child already has large stores of fat, this constituent of the diet should be kept as low as possible, to 50 grammes a day or below. Even this amount will provide 450 calories. The protein itself should not be less than 50 grammes daily and the carbohydrate may be reduced to 100 grammes or less daily if possible. This would give a diet of approximately 1,000 calories daily. Specimen diets containing 1,000, 1,250, or 1,500 calories respectively are given below.

Some children will often not tolerate these low calorie diets and complain of being hungry. In older children, it is permissible to give dextro-amphetamine (Dexedrine) to diminish the appetite, 1 or 2 five-mgm. tablets at breakfast time. The effects wear off in the afternoon so that sleep is not interfered with.

Another method of overcoming the appetite is the administration of 7½ gr. tablets of methyl-cellulose before meals. This inert substance swells up when it comes into contact with the digestive juices and gives a sense of fullness so that the desire for food is diminished.

Specimen Reducing Diet

1,000 Calories Diet

Breakfast:
5 oz. milk (1 teacupful).
1 oz. bread (1 slice size of Hovis loaf, ¼ in. thick).
¼ oz. butter (piece the size of a walnut).
1 egg, or 1 thin rasher of bacon, or piece of fish.

Mid-Morning: Cup of Marmite or raw fruit.

Dinner:
1 oz. lean meat or 2 oz. fish (average helping).
2 oz. potato (1 tablespoonful).
Large helping of green leaf vegetables or salad.
Pudding: 5 oz. milk sweetened with saccharine as a junket or jelly.
Stewed fruit with saccharine or fresh fruit (average helping).

Tea:
5 oz. milk (1 teacupful).
1 oz. of bread (1 slice size of Hovis loaf ¼ in. thick).
¼ oz. butter (piece size of half a walnut).
With Marmite, fish or meat paste, salad, or fresh fruit.

Supper:
5 oz. milk (1 teacupful).
½ oz. grated cheese (1 tablespoon) or 1 oz. sardines (3).
1 oz. bread (1 slice size of Hovis loaf, ¼ in. thick).
Fresh fruit or salad.

1,250 Calories Diet

Breakfast:
3 oz. milk in tea (half teacupful).
1½ oz. bread (1½ slices size of Hovis loaf, ¼ in. thick).
¼ oz. butter (piece the size of half a walnut).
1 egg, or 1 thin rasher of bacon, or 1 piece of fish.

Mid-Morning:
7 oz. milk (at school).

Dinner:
2 oz. lean meat or 4 oz. fish (average helping).
2 oz. potato (1 tablespoon).
Large helping of green leafy vegetables or salad.
5 oz. milk sweetened with saccharine as junket or milk jelly.
Fresh or stewed fruit and saccharine (average helping).

Tea:
3 oz. milk (½ teacupful).
1½ oz. bread (1½ slices, size of Hovis loaf, ¼ in. thick).
¼ oz. butter (piece size of half a walnut).
With Marmite, meat or fish paste, lettuce, tomato or fresh fruit.

Supper:
4 oz. milk as cocoa sweetened with saccharine.
1 oz. bread (1 slice size of Hovis loaf, ¼ in. thick).
¼ oz. of butter (piece size of half a walnut).
1 oz. cheese (2 tablespoons grated) or 2 oz. sardines.
Salad or fresh fruit (average helping).

1,500 Calories Diet

Breakfast:
3 oz. milk (½ teacupful) in tea.
2 oz. bread (2 slices size of Hovis loaf, ¼ in. thick).
½ oz. butter (piece size of a walnut).
1 egg or 1 thin rasher of bacon, or 1 piece of fish.

Mid-Morning:
7 oz. milk (at school).

Dinner:
2 oz. lean meat or 4 oz. fish (average helping).
4 oz. potato (2 tablespoons).
Large helping of green leafy vegetables or salads.
Pudding: 5 oz. milk to drink (½ teacupful), or 5 oz. milk sweetened with saccharine as junket or milk jelly.
Fresh or stewed fruit with saccharine (average helping).

Tea:
3 oz. milk (½ teacupful).
2 oz. bread (as at breakfast time).
½ oz. butter.
With Marmite, fish or meat paste, salad, tomato, or fresh fruit.

Supper:
4 oz. milk as cocoa, sweetened with saccharine if necessary.
1 oz. bread (1 slice ¼ in. thick).
½ oz. butter (piece size of a walnut).
1 oz. cheese (tablespoons grated) or 2 oz. fish.
Salad or fresh fruit (average helping).

Foods to be Avoided on Account of their High Calorie Value and Tendency to Fatten

Fried Foods

Frying of foods increases the calorie content greatly; in fact it almost doubles it. For example, 1 oz. of fried onions contains 101 calories. One slice of bread contains 70 calories, but if fried 156. All fried foods should therefore be avoided.

Puddings

Puddings such as castle pudding, treacle tart, suet puddings, dumplings, pancakes, Yorkshire pudding, fruit tarts, etc., are best avoided, or taken in very small quantities only. Their calorie content is very high, as will be seen from the attached list.

Cakes and Biscuits

All kinds are best omitted from the diet, in view of their high calorie content. Alternatively, biscuits, cakes, etc., as made by the Energen Company or Callard's should be substituted, when possible.

Sweets

All sweets, chocolates and toffees contain a large number of calories per ounce and should therefore be omitted.

Bread and Potatoes

These tend to form too high a proportion of the diet of many children and must be looked on as fattening foods, which should be taken sparingly, remembering that one thin slice of bread (sandwich loaf size) contains 70 calories, without the addition of butter, and one heaped tablespoonful of potato boiled and mashed contains 67 calories. One heaped tablespoonful of chip potatoes contains 124 calories. 1 oz. of Ryvita contains 98 calories, and 1 oz. of Vita Wheat 110, and these preparations should therefore be taken as sparingly as bread.

Sugar

A maximum of 4 oz. per week (less if possible) must be aimed at, including any used in cooking. This is 448 calories, and an appropriate number of calories must therefore be added when calculating any meal to which sugar has been added for sweetening. Tea, etc., is best taken without sweetening. Saccharine may be used occasionally.

Milk

All growing children require approximately one pint of milk per day in order to supply sufficient calcium for their needs, and up to three eggs per week (if obtainable) (dried eggs may be used). The full ration of butter (2 oz.) and bacon (4 oz.) and meat should be given each week.

Vitamins

Vitamin 'D', such as halibut-liver oil, should be given daily.

List of Foods with Calorie Values

	Calories
Bread, Cakes and Biscuits	
Buns (medium size—about 2 oz.)	250
Cake (per 2-oz. slice)	125
Biscuits (about ½ oz.)	68
Bread (one thin slice of a sandwich loaf) is 1 oz. (approx.)	70
Toast, ditto	70
Ryvita (per oz.)	98
Vita Wheat (per oz.)	110
Cereals	
Porridge (thin oatmeal, 4 tablespoonfuls (approx.)	80
Wheat Flakes (Kellogg's, etc.) per 4–5 tablespoonfuls (1 oz. approx.)	80
Dairy Produce	
Bacon (lean), 1 rasher (1 oz.)	125
Butter (per oz.)	226
Cheese (Cheddar) (per oz.)	120
Egg (boiled)	92
Egg (fried)	130
Margarine (per oz.)	226
Milk (full cream) (per oz.)	20
Milk (full cream) (per pint)	400
Fish (per 4-oz. portion)	
Most varieties of white fish when steamed	100
Herring	300
Kippers (per pair)	240
(*Note.*—If fried, the calorie content is practically doubled)	
Fruit (fresh or stewed per 4 oz., i.e., approx. 4 tablespoonfuls)	
Calorie content shown below is when fruit is stewed WITHOUT sugar	
Apple (fresh, raw)	40
Apple (baked)	40
Apple (stewed)	40
Apricots (dried, stewed)	70
Banana (one, peeled)	90
Blackberries (raw)	32

	Calories
Fruit (cont.)	
Blackberries (stewed)	16
Cherries (raw)	44
Cherries (stewed)	44
Dates (without cooking)	280
Figs (stewed)	140
Fruit salad (tinned in syrup)	80
Gooseberries (stewed)	12
Grapefruit (one-half)	15
Greengages (raw)	40
Greengages (stewed)	40
Loganberries (raw)	20
Loganberries (stewed)	20
Oranges (each)	35
Peaches (tinned in syrup)	76
Pears (raw)	25
Pears (tinned)	72
Pears (stewed)	28
Plums (raw)	40
Plums (stewed)	40
Raisins (seedless)	280
Raspberries (raw)	28
Raspberries (stewed)	20
Redcurrants (stewed)	24
Rhubarb (stewed)	4
Strawberries (raw)	28

Meats (per 4-oz. portion of lean meat)	
Beef (roast)	320
Chicken (roast or boiled)	220
Goose (roast)	220
Ham (lean)	240
Hare (stewed)	220
Heart (sheep's) stewed	280
Kidneys (fried)	220
Liver (fried)	320
Mutton chops (fried)	400
Mutton (boiled or stewed)	300
Pork (lean)	320
Rabbit (stewed)	200
Sausages (two, fried)	360
Shepherd's pie	140
Tripe (stewed)	120
Tongue	240
Veal (roast)	240

Preserves	
Golden syrup (per oz.)	84
Honey (per oz.)	82
Jam (per oz.)	74
Marmalade (per oz.)	74
Treacle (black) (per oz.)	73

(*Note.*—Approximately 4 small teaspoonfuls, not heaped, equal 1 oz.)

	Calories
Puddings (approximately 2 tablespoonfuls)	
Apple tart	240
Banana custard	120
Blancmange	140
Bread and butter pudding	180
Castle pudding	520
Egg custard	100
Dumplings	240
Pancakes (2 medium)	280
Rice pudding	210
Sago pudding	140
Yorkshire pudding (per portion)	150

Sugar and Sweets	
Sugar (white or brown) per oz.	112
Chocolate (per oz.)	150
Toffee (per oz.)	113

Vegetables (per 4-oz. portion, approx. 4 tablespoonfuls)	
Asparagus	20
Baked beans	100
Broad beans	50
Beans (haricot)	100
Beans (runner)	80
Beetroot	50
Broccoli	16
Brussels sprouts	20
Cabbage	12
Carrots	20
Cauliflower	12
Celery	12
Leeks	30
Lentils	100
Lettuce	12
Marrow	8
Onions (boiled)	16
Onions (fried)	400
Parsnips	65
Peas (fresh)	56
Potatoes (boiled and mashed) (TWO HEAPED TABLESPOONFULS ONLY)	136
Potato baked in its skin weighing approx. 4 oz.	100
Potatoes (chips) (2 heaped tablespoonfuls only)	248
Spinach	28
Spring greens	12
Swedes	24
Tomatoes (raw)	16
Tomatoes (fried)	89
Turnips	12
Turnip tops	12
Watercress	16

	Calories
'Made-up Dishes'	
Beef and steak pudding (2 tablespoonfuls)	176
Curried meat (4 tablespoonfuls)	192
Fish cakes (two medium size)	244
Fish pie (4 tablespoonfuls)	232
Hot pot (4 tablespoonfuls)	144
Irish stew (4 tablespoonfuls)	164
Kedgeree (4 tablespoonfuls)	172
Shepherd's pie (4 tablespoonfuls)	140
Steak and kidney pie (1 medium portion and meat)	340
Toad in the hole (one medium portion)	332
Soups (per teacup) (approx. 4 oz.)	
Bone and vegetable broth	72
Potato soup	104
Mixed soup (clear)	40

A scales for use in the child's own bedroom is found a great stimulus to dieting and aids greatly in securing the child's co-operation.

The above facts and figures were obtained from 'Chemical Compositon of Foods', McCance & Widdowson, Medical Research Council, Special Report Series, No. 235, 1942.

CŒLIAC DISEASE

Cœliac Disease is caused by the inhibitory effect of gluten on the absorption of fat from the intestine, although at present the mechanism is not known. Starch as such is harmless. Wheat flour and rye flour contain gluten, which is not present in maize flour, rice, or potatoes. These foods can therefore be given freely. A patient with cœliac disease is given a perfectly normal diet except for the exclusion of all gluten-containing foods. It is not yet known how long it is necessary to continue with this diet but probably it should be continued for some years.

Diet in the Treatment of Cœliac Disease

In a severely ill child with cœliac disease, commence with four-hourly feeds of skimmed milk, Prosol and glucose.

		Carbohydrate	Protein
30 oz. of skimmed milk	=	42.0 grams.	27 grams.
2 oz. of Prosol	=	14.0 grams.	36 grams.
4 oz. of glucose	=	120.0 grams.	
Total calories	=	956	

Divide into seven 5-oz. feeds given at four-hourly intervals. Add ripe mashed banana. Commence with half a banana morning and afternoon.

Gradually introduce the gluten-free diet (see below). Replace skimmed milk with half-cream milk. Gradually change the half-cream milk to whole cow's milk.

The diet should allow 60 calories per pound body weight including 3–4 grammes protein per pound body weight.

Diet Sheet for Cœliac Disease (Free of Wheat and Rye Gluten)

Your child may have an entirely normal diet except that nothing may be given which is made from wheat flour or rye flour. As a substitute, pure wheat starch as supplied from The Hospital For Sick Children, Great Ormond Street, or from the Energen Food Co., Bridge Road, Willesden, London, N.W.10, may be used in unlimited quantities. It may be found useful to supplement the diet with soya flour which is also harmless. Potatoes may also be given in normal quantities.

The following are some examples of foods in common use which may NOT be given as they are made from or contain wheat or rye flour:

Bread
Biscuits
Cakes
Cream of Wheat
Doughnuts
Energen Rolls
Grape Nuts
Ice cream
Macaroni
Malted Milk
Noodles
Ovaltine
Procea Bread
Proferin Rolls
Packet cake mixture and pudding mixture
Packet soups and gravy browning
Pastry mix
Patent Foods
Puffed Wheat
Paste (fish or meat)
Rusks
Ryvita
Semolina
Spaghetti
Shredded Wheat
Sweets of unknown composition
Salad Cream
Sausages
Tinned Soups and Meats
Vita Wheat
Sauces (commercial)
Vermicelli
Weetabix

No breakfast cereal foods other than those specifically recommended should be given. The following, however, are harmless:

Cornflakes
Puffed Rice
Rice Krispies
Porridge

Gravies and sauces may be thickened with pure wheat starch or cornflour but not with ordinary flour.

Ordinary household cocoa may be given but not proprietary preparations (such as Ovaltine).

Note.—Do not give any other foods unless you are quite sure they are entirely free of wheat or rye flour.

Gluten-Free Diet

Breakfast: Cornflakes, Rice Krispies, or porridge. Sugar. Cow's milk. Boiled or poached egg, bacon and tomato. Wheat-starch biscuits, soya biscuits, cornflour biscuits, or wheat-starch loaf. Butter, jam, etc.

Dinner: Average portion of meat, chicken, fish. Spinach, cauliflower, cabbage, or carrots. Potatoes, boiled, baked or fried. Rice pudding, cornflour, blancmange, junket, jelly, stewed fruit.

Tea: Milk or weak tea to drink. Jelly, fruit, tomato, honey, jam, syrup. Wheat-starch biscuits, cornflour biscuits, wheat-starch loaf or cakes (from given recipes). Butter.

Supper: Egg custard, fruit purée, or grated cheese and salad. Wheat-starch, cornflour, or soya biscuits.

Recipes

Wheat Starch Biscuits

Ingredients:
8 oz. wheat starch.
4 oz. margarine.
4 oz. castor sugar.
1 small egg or 2 tablespoons of milk.
Flavouring—grated orange or lemon rind.

Method. Cream margarine and sugar. Add egg and flavouring. Sift in wheat starch. Knead to a stiff paste. Roll out thinly. Cut into shapes and place on a greased baking sheet.

Cooking Time. Regulo 4 for approximately 15 mins.

Amount. This quantity makes approximately 1 lb. of biscuits.

The mixture can be piped. Mix the paste to a dropping consistency and pipe through a forcing bag.

Cooking Time. 15 minutes at Regulo 6.

Wheat Starch Cakes (small)

Ingredients:
7½ oz. wheat starch.
4 oz. sugar.
4 oz. margarine.
1 egg.
1 level teaspoon of baking powder.
Flavouring—vanilla, orange, lemon or chocolate.

Method. Cream margarine and sugar until fluffy. Add the egg (well beaten) and flavouring. Fold in the flour. Mix to a soft dropping consistency. Place two teaspoons of the mixture in greased bun tins.

Cooking Time. Cook at Regulo 5 for 30 minutes.

Amount. This quantity makes approximately eighteen small cakes.

N.B.—Household cocoa, glacé cherries, peel, or dried fruit may be added as variations in flavour.

Wheat Starch Pudding

Ingredients: 6 oz. wheat starch.
4 oz. sugar.
4 oz. margarine.
2 eggs.
½ teaspoon baking powder.
Grated lemon or orange rind.
A little milk to mix.

Method. Cream the fat and sugar together. Add flavouring and beat well. Sift flour and baking powder. Beat the eggs well. Add alternate amounts of flour and eggs. Mix to a soft dropping consistency with a little milk. Drop the mixture into small prepared moulds. Cover with greaseproof paper.

Cooking Time. Place in boiling water. Steam for 45 minutes in a closed saucepan. Serve with hot custard or jam sauce.

Amount. Eight helpings.

Wheat Starch Pudding

Ingredients: 1½ oz. wheat starch.
1 oz. sugar.
1 pint of milk.
1 egg (optional).
Pinch of salt.
Flavouring.
1 oz. margarine or butter.

Method. Bring the milk to the boil in a double saucepan. Blend the wheat starch with a little cold milk. Pour into the boiling milk, whisking well to avoid lumps. Add sugar and butter, stir until dissolved. Cook for 20 minutes. When warm whisk in the well-beaten egg.

Cooking Time. 20 minutes after adding cereal.

Amount. This quantity makes four servings.

Gluten-Free Bread made with Yeast

Ingredients: 12 oz. wheat starch.
1 oz. yeast.
1 teaspoon of sugar.
1 oz. cooking fat.
1 teaspoon of salt.
8 oz. cold milk.
4 oz. boiling water.

Method. Add the salt to the wheat starch and rub in the fat. Cream together the sugar and the yeast and add the warm milk and water. Mix all ingredients into a batter and pour into a well-greased tin. Allow to stand in a warm place for 20 minutes. Cook at Regulo 5 for 20 minutes then at Regulo 7 for 5 minutes. Remove loaf from the tin and place it on the oven shelf for a further 15 minutes.

Gluten-free bread may now be obtained from Birkett and Bostock, Ltd., Stockport. The loaves weigh approximately 11 oz. each, and keep in good condition for about one week. The cost per loaf is 1s. 3d. plus postage.

Chocolate Crisps

Ingredients: 4 oz. milk chocolate.
Rice Krispies.

Method. Break the chocolate into pieces, melt in basin, placed in a saucepan of hot water. Stir in the Rice Krispies until they are coated with chocolate. Place in small heaps on a greased tray and allow to set.

DIET IN FIBROCYSTIC DISEASE OF THE PANCREAS

In this disease there is almost complete destruction of the exocrine tissue of the pancreas. The cause is an abnormality of mucous secretion present since birth. The mucus is extremely viscid and blocks the alveolar ducts, causing dilatation of the acini.

Owing to the almost complete absence of pancreatin enzymes, digestion is seriously impaired and the baby fails to thrive. The appetite is good so that a high calorie intake can be given. Extra protein in the form of Prosol, or Caseinol should be added to the milk. When the infant is having a solid diet, plenty of protein and carbohydrate should be given with a moderate fat intake. Pancreatin is given before meals to substitute for the absent pancreatic trypsin.

DIET IN INFECTIVE HEPATITIS

The diet in this condition should be low in fat and high in carbohydrate and protein. The low protein diet previously recommended is not now considered necessary. Proteins containing a high content of methionine such as milk and cheese should be given. Skimmed milk which contains a considerable amount of protein is valuable. Lean meat, steamed fish, and chicken may be given.

In the first few days of the illness, nausea and vomiting are present and the patient can take only sweetened fruit juices, and skimmed condensed sweetened milk at frequent intervals.

After these symptoms have passed off, a diet such as the one suggested above should be given. A sufficient allowance of starchy foods should be given at each of the three meals. Porridge, any of the dried cereals, rusks, honey, jam, treacle, etc., together with the skimmed milk make up a suitable breakfast. For the mid-day meal a helping of lean meat, chicken, rabbit, or steamed white fish may be given with sieved vegetables, followed by stewed fruit, semolina or rice pudding made with skimmed milk. For tea, thin toast or rusks with a scraping of butter, honey, or jam sponge cake, and skimmed milk may be given. Glucose and fruit juices should be given throughout the illness. Stewart and Witts[1] were unsuccessful in shortening the disease by administration of 5 grammes daily of Methionine.

[1] *Brit. Med. J.*, 1945, 1, 399.

When the jaundice has disappeared, and the colour of the stools has become normal, a gradual return to a normal fat intake should be made.

DIET IN FEVER

(In colds, influenza, tonsillitis, bronchitis, pneumonia, and infectious diseases such as measles, scarlet fever, etc.)

It has been shown that a great increase of metabolism occurs in fever. At the height of the fever the basal metabolic rate may be raised 40–50 per cent above normal. This is probably due to the action of toxins rather than to the temperature itself.

If an adequate calorie intake is not given, the patient wastes owing to the burning of the fat and muscle protein to provide energy for the patient's basal metabolic requirements. Carbohydrate is a protein sparer, and should be given in considerable quantities.

A febrile child therefore requires:

1. A high calorie intake up to 40 calories per pound of body weight.

2. The carbohydrate should form about 60 per cent of the total and is best given in the form of sugar, e.g., cane sugar, or glucose added to fruit juices, e.g., oranges, lemons, grapefruit.

To increase the carbohydrate content of the diet any of the proprietary starch foods may be added to the milk, e.g., Benger's, Farex; semolina or rice puddings are often well tolerated.

3. The protein is best given in the form of milk and eggs which is well digested. Eggs may be beaten up with part of the milk given. The milk can be diluted with water. About 50–60 grammes of protein should be given supplying 200–250 calories.

4. Fats should be given in small quantities. There will be a certain amount of fat in the milk. Ice cream is well tolerated and contains both fat and carbohydrate.

In the early stages of the illness, feeds should be given in small quantities at two-hourly intervals on the lines indicated above.

As soon as the temperature falls, and the appetite returns, more solid food may be given such as steamed white fish, minced lamb, chicken, chopped vegetables, cereal, puddings, custards, and bread and butter or fresh fruit.

DIET IN TYPHOID FEVER

The same considerations hold as for an ordinary fever diet. Typhoid patients particularly require a high calorie intake if wasting and loss of strength are to be avoided.

During the early acute phase, milk and cereals together with ice cream or plain chocolate can be given in sufficient quantities to sustain the child's strength. Quite quickly, however, a more solid diet containing very little roughage is indicated. Scrambled eggs, steamed white fish, pounded chicken, broth, pounded brains, creamed potato, calves' feet jelly, milk puddings, with custard, junket and finely puréed stewed fruit can be introduced.

Throughout the illness, fresh fruit juice drinks should be given, and as far as possible the regular meal times should be adhered to.

The risk of perforation due to food eaten, provided everything is soft and has been passed through a sieve, is minimal. Greater errors are made in under-feeding than in over-feeding in this disease. Should the milk be undigested with curds in the stools, it should be fully peptonized.

DIET FOLLOWING TONSILLECTOMY

After the removal of enlarged tonsils the swallowing capacity of children differs; some children are able to swallow only with difficulty and others are less affected and are capable of enjoying a substantial type of meal within forty-eight hours of operation.

For the child who finds swallowing painful and difficult, alternate iced fruit drinks, jelly, iced milk shakes, and soft ice cream are very suitable, and soothing to the throat, and should be given at frequent intervals. On the third day, soup, minced meat, mashed fish, lightly-cooked eggs, sieved vegetables and creamy milk pudding with fruit purée may be given. After this the diet should become normal.

DIET IN ALLERGY

It is probably true to say that the part played by foods in producing allergic manifestations (eczema, asthma, urticaria, hay-fever), in infants and children, is much overrated.

Eczema is rarely caused by an article of diet, though occasionally an infant is allergic to egg albumin or milk. Milk should be

well boiled or dried and both eggs and cereal should be well cooked. Bray[1] has claimed that hydrochloric acid milk is less likely to provoke eczema than ordinary milk.

Asthma may be caused by foods though not commonly. The history is usually suggestive when asthma develops within a few hours of ingesting certain foods, *e.g.*, eggs, milk, cheese, fish, etc. Skin tests with food allergens can be very misleading and foods should not be excluded from the diet on the basis of positive food tests alone without confirmatory evidence.

Urticaria (*Lichen Urticatus*) may be caused by certain foods, e.g., fish, strawberries, or other soft fruit. Excess of carbohydrate may also bring on urticaria. Ephedrine or one of the antihistamine drugs are helpful in aborting the attacks.

When a food allergy has been discovered the food or foods should be excluded from the diet. Often as the child grows older, the sensitivity to the food gradually diminishes, and may ultimately disappear.

Intolerance of infants to cow's milk has been mentioned in Chapter VII, p. 123.

DIET IN ANÆMIA
(Nutritional or Iron Deficiency Anæmia)

This type of anæmia is found in older infants who are exclusively breast fed, in premature infants and in twins, or in children who, for various reasons, have been kept on a diet relatively high in starch and low in protein. The blood count in such cases shows a normal number of red cells, but a low haemoglobin, with a consequent low colour index (hypochromic microcytic anæmia).

Treatment. A blood transfusion is the quickest way to make good the haemoglobin deficiency in severe cases, i.e., when the haemoglobin is below 50 per cent.

Diet. The diet should be adjusted so that a liberal supply of iron containing foods are given (see p. 165). The various vitamins should be present in the diet (see pp. 166-172). Iron should be offered as ferrous sulphate and should be given to premature babies and twins from the first month onward. Mackay[2] has shown

[1] Bray: *Recent Advances in Allergy,* 3rd Ed., 1932. J. & A. Churchill, London.
[2] Mackay, H. M. M.: *Arch. Dis. Child.,* 1933, 8, 251.

that a large proportion of infants suffer from mild nutritional anæmia, and recommends giving iron to all infants.

Iron Content of Common Articles of Diet

	Mgms. of iron per oz.
Kellogg's All Bran	3.06
Grapenuts	1.60
Shredded Wheat	1.27
Egg Yolk	1.74
Corned Beef	2.78
Stewed Beef	1.45
Boiled top-side of Beef	2.36
Stewed Hare	3.07
Sheep's Heart	2.30
Sheep's Kidney (fried)	4.12
Liver (fried)	6.15
Cod (fried)	0.28
Apple (raw)	0.08
Plum (stewed)	0.08
Lettuce	0.21
Spinach (boiled)	1.14
Watercress	0.46
Steak and Kidney Pie	1.58
Milk	0.02
Cheese	0.16

APPENDIX I

THE VITAMINS

The influence of vitamins in nutrition and scientific feeding is now firmly established. From a functional feeding point of view, some knowledge of the vitamins is essential. For a more detailed discussion, reference must be made to the appropriate textbooks.

Vitamin 'A' (Fat-Soluble)

The chief sources of Vitamin 'A' are mammalian or fish liver, egg yolk, butter, cream and a number of vegetables, e.g., carrots, spinach, peas, and beans. It is absent from most vegetable oils and cereals, except maize.

Vitamin 'A' activity is also possessed by certain carotenoids which are converted to Vitamin 'A' in the body. These pro-vitamins give the yellow colour to many fruits and vegetables. They are also found in green vegetables in association with chlorophyll.

The carotenoids are much less easily utilized than Vitamin 'A' itself. Any disturbance in the fat absorption will affect the absorption of Vitamin 'A', e.g., Cœliac Disease.

Vitamin 'A' is soluble in fats and fat solvents. It is resistant to heat in the absence of air but it is readily destroyed by oxidation at all temperatures. About 95 per cent of Vitamin 'A' is stored in the liver.

The daily Vitamin 'A' requirements have been estimated on the basis of blood levels to be between 50 and 100 units per pound body weight. A daily dose of 1,500 units would appear to be sufficient for a healthy infant. Infections decrease the absorption of Vitamin 'A' so that extra amounts of the vitamins must be given.

The Vitamin 'A' activity of both human and Cow's milk is due to a mixture of Vitamin 'A' and Carotene, the total amount depending on the diet in the case of human beings, and the food and breed in the case of cattle. 100 grams contain about 150 units.

Vitamin 'A' deficiency causes failure to gain weight and there is a disturbance of orderly bone growth, dryness and later hyperkeratosis of the skin, xerophthalmia and corneal ulceration, night

blindness and cornification of the epithelial linings of the respiratory, alimentary and urinary tracts. These latter changes predispose to infection.

From the fact that Vitamin 'A' is present in considerable quantities in milk and that most infants receive added Vitamin 'A', deficiency symptoms are extremely rare in this country.

The Vitamin 'B' Complex (Water Soluble)

Vitamin 'B' is now known to contain several substances. (Ten have been isolated in pure forms.) For a detailed description, reference must be made to books dealing with the subject.

The 'B' Vitamins generally tend to occur in nature together. A deficiency of a single vitamin rarely occurs.

The most important fractions of Vitamin 'B' are:

'B' Vitamin	*Absence of which produces:*
'B_1' (Aneurine or Thiamin)	Beri-Beri. A form of polyneuritis.
'B_2' (Riboflavine)	Fissures at corners of mouth, cheilosis, and vascularization of the cornea.
Nicotinic Acid	Pellagra.
'B_6' (Pyridoxin or Adermin)	Dermatitis with acrodynia.

Other members of the B-Complex are: Pantothenic acid, Folic acid, Inositol, Biotin, Choline and Vitamin 'B_{12}'.

Gross Vitamin 'B' deficiencies are rarely seen in this country but it is claimed that where this is only a slight deficiency, lack of appetite, digestive upsets, and failure to gain weight occur.

Generally speaking, the foods which contain a rich supply of Vitamin 'B' complex are wheat germ, most other cereals, yeast extract, milk, eggs, meat, liver, kidneys, leafy vegetables, and to a lesser extent, fruit. Nuts and bran, pork and wholemeal bread also contain this complex. Cow's milk contains more Thiamine and much more riboflavine than breast milk but the amount of nicotinic acid in both, is low. Estimated requirements of the Vitamin 'B' complex are given on p. 178.

Vitamin C (Ascorbic Acid) (Water Soluble)

This vitamin has been isolated as a colourless crystalline compound, known as ascorbic acid. It has been synthesized. It is

easily destroyed by heat. Ascorbic acid is a strong reducing agent, and is, therefore, easily oxidized, with destruction of its vitamin activity. Oxidation is favoured by the presence of oxygen, light and even minute traces of copper.

Among the best sources of Vitamin 'C' are:

1. Citrus fruits, such as grapefruit, oranges and lemons. Some of these fruit juices are bottled and must be looked upon as an excellent source of Vitamin 'C'.

2. Vegetables, such as broccoli, watercress, mustard and cress, sprouts, spinach, cabbage, tomatoes, cauliflower, turnips, parsnips, and potatoes. Turnips or swedes may be cut into small pieces and put through a press. The juice resulting, if used at once, is suitable for infants and children, but it must not be kept. Potatoes cooked in their jackets constitute an excellent source of Vitamin 'C'.

3. Summer fruits. During the summer redcurrants and blackcurrants, raspberries, gooseberries and strawberries are available and these contain much Vitamin 'C'. During the winter months, these fruits may be available in a preserved form—bottled or tinned.

Blackcurrant purée as supplied at Welfare Centres is prepared so that three teaspoonfuls represents about 25 mgms. of Ascorbic Acid. Rose-hip syrup is also supplied at some Welfare Centres and is also rich in ascorbic acid.

Tomato and prune juice are also good sources of the vitamin. Tomato juice contains one third to a half as much Vitamin 'C' as orange juice.

The amount of Vitamin 'C' in cow's milk depends on several factors. It is greatest in spring and summer when the cow is at pasture. Milk fresh from the cow at these seasons contains approximately 10 mgms. per pint.

Pasteurization reduces the amount by about one-third. The vitamin content progressively diminishes as the milk is kept. Much of the Vitamin 'C' is destroyed in the heat treatment employed for dried milk.

Evaporated milk has also a reduced amount of Vitamin 'C'. Sweetened evaporated milk contains more.

All infants fed on artificial foods should have a daily Vitamin 'C' supplement.

The amount of Vitamin 'C' in human milk varies with the vitamin content of the mother's diet. It may be very small if the mother's intake of Vitamin 'C' is low. The average value is about 25 mgm. per pint.

Twenty mgms. per day is probably the minimum requirement but the older infant requires about 50 mgms. per day.

Marked deficiency of Vitamin 'C' results in scurvy. In this disease haemorrhage is the main feature. This seems to be due to seepage of blood through the capillary walls, owing to some defect in the connective tissue cells in the capillaries. Vitamin 'C' is known to be essential to the maintenance of normal connective tissue cells, and of the cells of the bones and teeth. In scurvy there is haemorrhage beneath the periosteum of the bones, and haemorrhage from the gums.

Deficiency of Vitamin 'C' causes delayed healing of wounds.

Vitamin D (Fat Soluble)

Vitamin 'D' is soluble in fat oils and fat solvents. It is very stable to heat and oxidation. Vitamin 'D' is present in milk, cream, eggs, butter and a few other foods but the amounts present are small compared with the requirements of the growing infant. The amount in cow's milk is greater in summer than in winter. Fish-liver oils, especially halibut-liver oil, are rich sources of the vitamin. Government cod-liver oil has a minimum potency of 200 units per gramme (12 per minim), whereas, halibut-liver oil contains 3,000 units per gramme. Vegetable foods are a poor source of the vitamin.

As the diet of an infant contains relatively small amounts of Vitamin 'D', added Vitamin 'D' must be given especially in winter time, and should be started not later than two weeks after birth.

There has been some difference of opinion as to the daily requirements of Vitamin 'D'. These are probably in the region of 400–500 units daily (i.e., 1 drachm or a teaspoonful of a good quality cod-liver oil). Large doses are dangerous as they produce toxic symptoms.

Vitamin 'D' can be produced by the action of the ultra-violet light present in the sun's rays on the skin which contains a pre-cursor of Vitamin 'D'. In this country ultra-violet light is only

present in the sunlight in adequate amounts in high summer, and even then, babies are often wrapped up so they do not receive much benefit from the sun's rays.

There are two forms of Vitamin 'D'.

Vitamin 'D_2' (Calciferol or Irradiated Ergosterol). This is found naturally in vegetables.

Vitamin 'D_3' (7-dehydrocholesterol). Present in fish-liver oils.

There is no Vitamin 'D_1'.

Vitamin 'D' is essential to the proper utilization of calcium and phosphorus. Deficiency of the vitamin results in defective ossification, with the formation of osteoid tissue at the ends of the bones. (i.e., bone with little calcium). The calcification of the shafts is deficient so that bending of the weight-bearing bones occurs producing severe deformities. Owing to irregular ossification enlargement of the ends of the bones takes place. In some cases the serum calcium is sufficiently low to produce tetany. In most cases of rickets the serum calcium is relatively normal but the phosphorus is low. Dentition is delayed and calcification of the teeth is defective.

Vitamin K

This was first isolated by Dam in Copenhagen who called it Vitamin 'K' (Koagulations-vitamin). He discovered it in investigating a fatal haemorrhagic disease in fowl which was due to lack of Vitamin 'K'.

Vitamin 'K' was found to be essential for normal blood clotting in the human being. It is a precursor of prothrombin, the synthesis taking place in the liver. Natural sources of this vitamin are certain grasses, e.g., alfalfa grass (lucerne). Spinach is also a rich source. Cauliflower, cabbage tops, kale and soya beans have a fairly high vitamin content. Most fruits except tomatoes are poor sources of the vitamin.

The natural Vitamin 'K' is fat-soluble and is only absorbed from the intestine in the presence of bile salts. In obstructive jaundice, therefore, there is little or no absorption of Vitamin 'K' so that a haemorrhagic tendency develops.

Vitamin 'K' has been isolated and is chemically methylphytyl-naphthoquinone. (Menadione.) Many other derivatives of naphtho-

quinone have Vitamin 'K' activity and some are water-soluble, e.g., Methyl-naphthoquinone. These are absorbed from the intestine in the absence of bile salts. They are more useful therapeutically and can safely be given by injection, whereas the fat-soluble Vitamin 'K' is liable to produce abscesses.

A second source of the vitamin is from synthesis by the action of certain bacteria on the food. This process is well developed by the end of the first week of life.

The presence of adequate amounts of Vitamin 'K' can be measured by the level of prothrombin in the blood. In most newborn babies the prothrombin level is about 30 per cent of adult levels and may in the first week of life fall to 10 per cent without haemorrhage occurring. Levels below this figure usually result in haemorrhages. By the end of the first week the prothrombin level has risen, though adult levels are not attained until the end of the first year. Premature infants at birth have very low prothrombin blood levels and as is well known, tend to bleed very easily.

Haemorrhagic disease is now known to be due to deficiency of Vitamin 'K'. When haemorrhage ceases spontaneously or as the result of administration of Vitamin 'K', the blood prothrombin levels rise. The disease can be prevented either by administration of a Vitamin 'K' preparation to the infant soon after birth, by mouth or by injection, or by giving the mother an injection of the vitamin at least four hours before the birth of the baby.

In Rhesus Iso-immunization the blood prothrombin level at birth is very low and haemorrhages may occur. Vitamin 'K' should, therefore, be given to babies suffering from the disease.

Principal Food Sources of the Vitamins

xxx. Indicates that the food is an excellent source of the vitamin.
xx. Indicates that the food is a good source of the vitamin.
x. Indicates that the food contains the vitamin in varying amounts.

VITAMIN 'A'

xxx. Escarole (a green leafy vegetable), spinach, Alfalfa.
Carrots.
Animal fats and oils, glandular organs, eggs, milk.
Butter. Cod, halibut and other fish liver oils.
xx. Artichoke, green string beans, brussels sprouts, celery leaves, lettuce, green peas.
Pumpkin, sweet potatoes, green dried peas.
Tomato, banana, date, dried prune, water-melon (raw and tinned).

x. Cabbage, cauliflower, cucumber.
Turnip, beet, lentil, onion, parsnip.
Fresh apples, cooking figs, fresh grapes, orange juice, grape-fruit, lemons, peaches.
Barley, bran, commercial bread, cottonseed.
Nuts, almonds, Barcelona nuts, Brazil nuts, walnuts and peanuts. Seed oils.
Animal muscle tissues.

VITAMIN 'B_1'

xxx. Yeast, cereals (particularly wheat germ), beans, peas and seeds, spinach, kale, mustard greens. Tomato.
Milk, eggs, nuts. Asparagus (green).
xx. Heart, liver and kidney. Hog muscle.
Wheat (whole), rye, barley, oatmeal, maize, brown rice.
Potatoes, carrots, turnips.
Oranges, lemons, grapefruit, fresh prunes, apples and pears.
x. Meats (ordinary).
Milled wheat, maize, rice.

VITAMIN 'B_2'

xxx. Cereal products, yeast, milk, lean meat, green leaves.
Liver.
xx. Tomatoes, eggs, milk, fish.
x. Maize, butter.

VITAMIN 'C'

xxx. Lemon juice, grapefruit juice, orange juice, tomato juice (fresh or tinned), swedes, turnip, spinach, watercress.
xx. Lime juice, raspberries and cloudberries, fresh cherries, fresh apples, carrots, potatoes, onions, cabbage, germinated seeds, watermelon.
x. Grape juice, pears, apricots, peaches, plums. Raw milk.

VITAMIN 'D'

xxx. Fish liver oil (goose-fish liver, herring, sardine oil and cod- and halibut-liver oil). Puffer-fish liver oil.
Egg-yolk, butterfat, whole milk.
xx. Green leafy foods.

VITAMIN 'E'

xxx. Lettuce leaves, wheat embryo.
xx. Seed oils and vegetable oils.
x. Bananas and oranges. Animal tissues.

VITAMIN 'K'

xxx. Spinach.
xx. Cauliflower, cabbage tops, carrots, kale.
x. Tomatoes. Bran.

Note.—For the vitamin content of the numerous vitamin preparations, see C. Asher: *The Practitioner*, 1945, 154, pp. 163–179.

APPENDIX II

SALINE SOLUTIONS

Normal saline is made by dissolving one drachm (a heaped teaspoonful of salt in a pint of water and sterilizing by boiling). It is used to replace fluid lost by the infant in cases of marked diarrhœa, vomiting, and in shock resulting in dehydration. It may

be given *intravenously*, though this is a matter of difficulty in infants or small children, requiring specialized skill. The *subcutaneous route*, i.e., the injection of the saline into the subcutaneous tissues over the chest or abdomen, is the best method. The amount given (after the saline has been raised to body temperature) will depend on the size of the patient. If hyaluronidase is added to the fluid, up to 200–300 c.c. may be given in quite a short time as it is absorbed quickly. Care must be taken not to over-distend the tissues as, in the debility which accompanies dehydration, the skin over the site of the injection has been known to slough when an attempt was made to give too much saline. Saline has been given *directly into the peritoneal cavity* by pinching up a fold of the lax abdominal wall and inserting a needle parallel to the surface. This method is certainly not devoid of the risk of infection and of puncturing the underlying gut.

Half-strength normal saline is made by dissolving half a drachm (a level teaspoonful) of salt in a pint of water and sterilizing as before by boiling. It is unsuitable for subcutaneous injection, but is of marked value when given by mouth. In cases of dehydration half-strength saline appears to be more readily retained by and absorbed from the infant's stomach. It may be freely given as a drink from time to time or several ounces may be left in the stomach after a gastric lavage.

Saline and Glucose. In giving subcutaneous or rectal salines, it is as well to give glucose with it, as this acts not only as food, but also combats accompanying ketosis. The strength of glucose given with subcutaneous saline is $2\frac{1}{2}$ per cent and with rectal saline, from 5 to 10 per cent.

GASTRIC LAVAGE

Washing out a baby's stomach may be found necessary in the treatment of persistent vomiting. This procedure is one which all those engaged in the care of infants should be able to perform, and it should not be looked upon as a difficult matter.

The necessary apparatus consists of a soft rubber oesophageal tube (No. 10 or 12), to the open end of which is attached a glass funnel by means of a glass connection and a short piece of rubber tubing.

There is little difficulty in passing the tube into the baby's stomach, provided the outside of the tube has been thoroughly wetted before doing so. Normal saline, warmed to about 100° F. should be used, and care must be taken not to over-distend the infant's stomach by pouring in more than a few ounces in the first instance. A good rule is to remove a funnelful of saline for each funnelful poured in. By alternately raising the funnel above and then depressing it below the level of the infant, fluid may be run into, or syphoned out of the stomach. The lavage should be continued until the washings return clear, i.e., unaccompanied by food debris or mucus. Finally, if considered necessary, some saline may be left in the stomach at the end of the lavage.

COLONIC LAVAGE

For washing out the rectum and lower few inches of the colon, an apparatus similar to that described for gastric lavage may be used. Warm saline should be preferred to ordinary water. The buttocks are raised on a pillow covered with mackintosh sheeting, and the well-greased tube gently inserted to a distance of 1–2 in. The level of the funnel should not be more than 18 in. above the infant, in order to prevent over-distension. It is very unlikely that any fluid will be retained at the end of the wash-out.

EXPRESSION OF BREAST MILK

Milk may be expressed from the breast by the following method. A tumbler should be arranged on a bed-rest or table below the level of the breast, so that the stream of milk can be directed into the glass without discomfort or change of position.

First Stage. Both hands should encircle the breast high up, and pass forward and downward towards the nipple with gentle kneading motion. This should be repeated several times to stimulate the flow (see Fig. 15).

Second Stage. Support the breast with one hand, and with the finger and thumb or the other, slightly smeared with cold cream or vaseline, grasp the nipple just above the aerolar margin. Great pressure is not required. The finger and thumb should draw out the nipple, exerting a gentle squeezing action while sliding towards the outlet of the nipple, to force out the milk. This operation may

Fig. 15 (*a*)
Manual expression of Breast Milk. Stage i.

15 (*b*)
Manual expression of Breast Milk. Stage ii.

[*To face p. 174*

have to be repeated several times before the flow is started, and should be continued smoothly and regularly. A start is more easily obtained if the nipple is grasped from above and below, or directly from side to side, that is, the grasp should be horizontal or vertical (see Figure).

At a first attempt one grip may be easier and more successful than the other, but, when the knack of starting the flow has been acquired, the grip should be changed at intervals to avoid producing soreness and friction. If the stream fails before the breast is emptied, or emerges only in drops instead of in jets, gentle massage, as in the first stage, helps to restore it, and at the same time rests the nipples.

APPENDIX III

THE CLEANING AND STERILIZATION OF INFANT FEEDING BOTTLES AND TEATS

A recent investigation was undertaken by the Medical Research Council to assess the relative merits of boiling and hypochlorite treatment of infant feeding bottles and teats.[1]

Neither method is foolproof. Each will fail if not properly carried out. The laboratory experiments demonstrated clearly that sterility of both bottles and teats can be achieved either by boiling or by immersion in a hypochlorite solution provided each method is correctly used. Each method may fail if sufficient attention to detail is not paid. The complete submersion of the teat is an important point.

Cleaning

After each feed the bottle should be rinsed with cold water and brushed out with warm water to which a milk cleansing agent such as washing soda or other detergent has been added. A bottle brush should be kept specially for the cleaning of feeding bottles, and should be boiled frequently. The bottle brush should *not* be kept in hypochlorite solution because this may corrode the metal part of the brush.

The teat should first be washed with cold water before it is removed from the bottle so as to rinse off any film of milk which

[1] Bull: *M. of H. and Publ. Health Lab. Service*, 1953, 12, 209.

might otherwise remain in a groove after the teat has been taken off the bottle.

The bottles and teats should as far as possible be rinsed free from cleaning agents.

Disinfection

Boiling Method. The cleaned bottle and teat should be totally submerged in cold or warm water in a suitable covered container. The water should be gradually raised to boiling point and allowed to boil for five minutes. They should be left to cool in the water and the container kept covered until the next feed. Before removing the bottle and teat, which should be handled as little as possible, the hands should be thoroughly washed.

The Hypochlorite Method. The cleaned bottle and teat should be totally submerged in the hypochlorite solution for a period of not less than three hours. Air bubbles must be excluded. (The teat may be kept in a small glass jar, or a special plastic cup. In any case it must be completely immersed.) Cold or warm water but not hot water should be used, and the solution should be changed daily.

A suitable hypochlorite solution may be prepared as follows:

To 5 pints of water add one tablespoonful ($\frac{1}{2}$ fluid ounce), of Solution of Chlorinated Soda B.P.C. 1934. Smaller quantities may be used, i.e., $\frac{1}{4}$ oz. (two teaspoons) to $2\frac{1}{2}$ pints of water. Proprietary solutions of sodium hypochlorite, e.g., Milton, may be used and diluted according to the maker's instructions relative to the sterilization of feeding bottles. As with the boiling method, the hands must be thoroughly washed before removing the bottle and teat from the solution, and both should be handled as little as possible. The solution should be allowed to drip off the bottle and the teat, but they should not be rinsed with water.

It should be emphasized that besides sterility of bottles and teats the avoidance of subsequent contamination and the sterility of the feed itself are of equal importance.

APPENDIX IV

RECIPES

Fish Cakes

Ingredients: $\frac{1}{4}$ lb. of cooked fish.
$\frac{1}{4}$ lb. of potatoes (put through a fine sieve).

1 oz. of butter.
Pepper and salt.
1 egg.
Breadcrumbs.
Fat for frying.

Method. Remove skin and all bones from the fish and mash very finely with a fork mixing in already sieved potatoes. Add pepper and salt. Melt the butter in a saucepan and stir in the potato and fish mixture. Beat up an egg and add to the mixture, stirring altogether very thoroughly with a fork and cook until it adheres to the fork. Turn out on to a board and shape into small fish cakes about one and a half inches deep. Brush over with egg and cover with breadcrumbs. Fry the fish cakes slowly until cooked.

Lemon or Orange Flummery

Ingredients: Grated rind of an orange or lemon.
2 oz. of castor sugar.
2 eggs.

Method. Separate the yolks of the eggs from the whites. Beat the yolks with castor sugar for 10 minutes, add the grated rind of the orange or lemon. Put this mixture on one side and beat the whites of the eggs with castor sugar until stiff. Fold this into the other mixture. Serve in small glasses and use at once.

The most preferable beater to use for this recipe is the wheel beater. This can be obtained in most of the big stores at a reasonable price. There is one made by 'Prestige'.

Raspberry Purée

Ingredients: 1 lb. of fresh raspberries.
¼ pint of cream.

Method. Put the raspberries through a fine hair sieve. A fine sieve must be used as otherwise the pips will come through. Whip the cream stiffly and pour into the sieved raspberries. Serve in glasses.

Prune Mould

Ingredients: 1 lb. cooked prunes.
¼ oz. powdered gelatine.
Hot water.

Method. Sieve the cooked prunes. Dissolve the gelatine in a little hot water and stir into the sieved prunes. Pour into glass dishes or moulds to set. Decorate and serve with cream.

Chocolate Spread

Ingredients: 2–3 oz. of plain chocolate.
2 oz. of butter.
Castor sugar.

Method. Melt the chocolate and beat to a cream with the butter, adding castor sugar to taste. Beat this mixture to a creamy consistency.

The chocolate spread should be kept covered in a cool place. It will keep for several days.

Home-Made Biscuits

Ingredients: 3 oz. of butter.
4 oz. of sugar.
6 oz. of flour.
1 egg.
Browning.

Method. Beat the butter and sugar to a creamy consistency. Break the egg and beat into the mixture. Add flour and mix well. Turn out on to a pastry board and roll out until a quarter of an inch thick. Cut into shapes and bake in the oven for 20–30 minutes.

In order to make these biscuits more attractive for children, it is possible to obtain nowadays animal shapes, e.g., rabbit, teddy bear, and a duck. The animal shapes are obtainable at most of the big stores at a reasonable price. The rabbit's whiskers and nose can be painted in with a fine paint brush and a little browning.

APPENDIX V

RECOMMENDED DAILY DIETARY ALLOWANCES

REVISED 1948

Food and Nutrition Board, National Research Council, Washington, D.C.

	Protein	Calcium	Iron	Vit. A	Thiamine	Riboflavine	Niacin (Nicotinic Acid)	Ascorbic Acid	Vit. D
	grams	grams	mg.	I.U.	mg.	mg.	mg.	mg.	I.U.
Under 1 yr.	3.5 kg. (2.2 lb.)	1.0	6	1,500	0.4	0.6	4	30	400
1–3 yrs.	40	1.0	7	2,000	0.6	0.9	6	35	400
4–6 yrs.	50	1.0	8	2,500	0.8	1.2	8	50	400
7–9 yrs.	60	1.0	10	3,500	1.0	1.5	10	60	400
10–12 yrs.	70	1.2	12	4,500	1.2	1.8	12	75	400

CALORIE REQUIREMENTS FOR CHILDREN

Age	McCance & Widdowson[1]		Holt & Fales[2]		Age	McCance & Widdowson		Holt & Fale	
	Boys	Girls	Boys	Girls		Boys	Girls	Boys	Girls
1	1,154	1,152	950	940	9	2,443	2,165	2,110	1,990
2	1,406	1,431	1,135	1,110	10	2,501	2,345	2,330	2,195
3	1,691	1,533	1,275	1,230	11	2,521	2,292	2,510	2,520
4	1,839	1,718	1,380	1,300	12	2,630	2,370	2,735	2,860
5	1,732	1,708	1,490	1,410	13	2,756	2,500	3,040	3,210
6	1,940	1,985	1,600	1,520	14	3,065	2,637	3,400	3,300
7	2,178	1,995	1,745	1,660	15	3,400	2,588	3,855	3,234
8	2,190	2,088	1,920	1,815	16	3,105	2,363	4,090	3,160

Both sets of figures are based on middle class children, but whereas Holt & Fales are based on only 100 observations, those of McCance & Widdowson's comprise over 1,000 observations.

It is interesting to note that the calorie intake of young English children is greater than young Americans but over the age of 10 the position is reversed.

[1] McCance & Widdowson. Quoted in Hutchison's *Food and the Principles of Dietetics.* Ed. Mottram and Graham E. Arnold. London 1948.

[2] Holt & Fales. (1921) *Amer. Jour. Dis. Child.*, 11, 1.

APPENDIX

TABLE SHOWING HEIGHT, WEIGHT, AND CIRCUMFERENCE OF THE CHEST AND HEAD FROM BIRTH TO THE SIXTEENTH YEAR (HOLT)[1]

Age	Weight in lb.		Height in inches		Circumference of the Chest in inches		Circumference of the Head in inches	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
			Recumbent					
Birth	7.4	7.1	19.8	19.8	13.1	13.0	13.7	13.9
3 months	14.3	13.0	24.1	23.3	16.0	15.7	16.1	15.7
6 „	18.7	17.0	26.5	25.8	17.3	17.0	17.3	16.9
9 „	21.7	19.7	28.3	27.6	18.3	18.0	18.0	17.6
12 „	23.8	21.9	30.0	29.2	18.9	18.6	18.5	18.1
18 „	26.9	25.0	32.5	31.9	19.6	19.2	19.2	18.7
			Standing					
1½ years	26.9	25.0	32.2	31.5	19.6	19.2	19.2	18.9
2 „	29.2	27.6	34.4	33.9	20.1	19.8	19.5	19.0
2½ „	31.5	30.1	36.3	35.9	20.4	20.3	19.7	19.3
3 „	33.5	32.5	38.0	37.6	20.7	20.5	19.8	19.4
3½ „	35.9	35.0	39.4	39.2	—	—	—	—
4 „	38.1	37.2	40.9	40.7	21.3	21.1	20.1	19.6
4½ „	40.5	40.0	42.4	42.2	—	—	—	—
5 „	42.8	42.3	43.6	43.5	21.8	21.5	20.2	19.8
6 „	48.2	48.3	46.3	46.3	22.3	22.0	20.4	20.0
7 „	54.2	54.5	48.7	48.7	22.9	22.4	—	—
8 „	61.0	61.9	51.1	51.1	—	—	20.7	20.4
9 „	68.4	69.6	53.3	53.3	24.6	24.2	—	—
10 „	76.8	78.1	55.5	55.5	—	—	20.9	20.9
11 „	85.6	88.4	57.4	58.1	26.6	26.0	—	—
12 „	95.2	100.4	59.6	60.7	—	—	—	—
13 „	105.7	110.5	62.0	62.8	28.4	27.8	—	—
14 „	119.1	120.1	64.9	64.1	—	—	—	—
15 „	132.3	126.6	67.4	64.9	31.0	28.6	—	—
16 „	141.9	130.5	69.0	65.2	—	—	—	—
17 „	147.6	133.5	69.5	65.2	32.4	29.2	—	—

Pulse Rate		Respiration Rate	
At Birth	140–120	At Birth	50–32
6 to 12 months	115–105	First year	35–25
2 to 6 years	105–90	2 to 4 years	25
11 to 14 years	85–75	5 to 14 years	25–20

Pulse-respiration ratio = 1 : 3½ or 4

[1] Holt's *Paediatrics*. Edit. by Holt and McIntosh. 12th Ed. 1953. Appleton, New York.

LIQUOR RINGE-LACTATIS (HARTMANN'S SOLUTION)

For oral, subcutaneous, and intravenous use
B.P.C. Add. Part III

Rx. Sod. Lact.	.. ..	0.25 per cent
Sod. Chlorid	.. ..	0.6 „
Pot. Chlorid	.. ..	0.04 „
Calc. Chlorid	.. ..	0.02 „
In aqua Dest.		

THE IRON MEDICINE

Rx. Ferrous sulphate	.. ..	gr. $1\frac{1}{2}$
Hypophosphorus acid dil	.. .. ..	min. $\frac{1}{4}$
Syrup	.. ..	min. 20
Aq aurantii	.. ..	drachm 1

Sig. One drachm twice daily, added to the feed.

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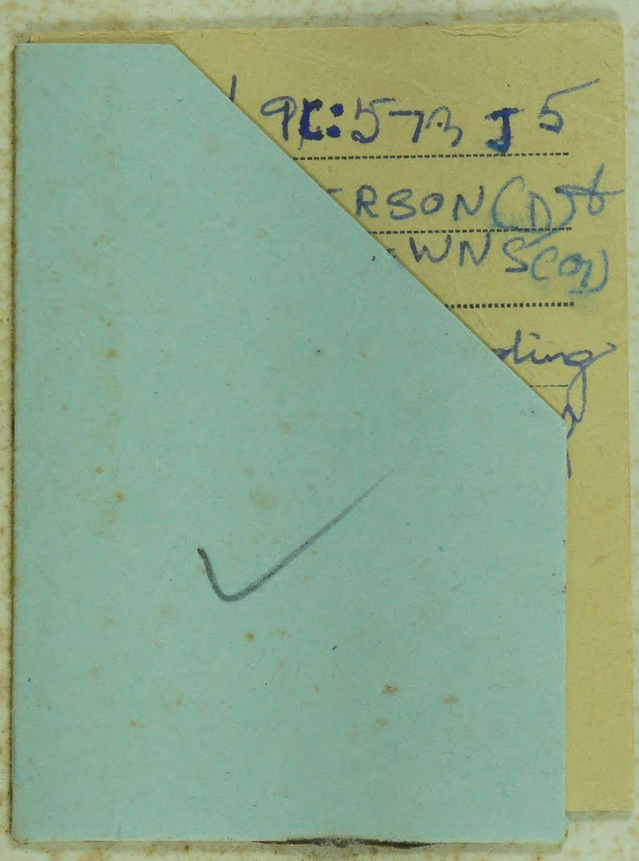
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